ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

NOVEMBER 1959

PRICE ONE DOLLAR

FOUNDED 1866

GIVE THE UNITED WAY...

UNITED

Salzgitter Brown Iron—Basis for a New Ruhr . . . . p 82

ALSO IN THIS ISSUE . . .

Graphic locator speeds mapping . . p 93

Mexico will treat Pachuca tails . . p 94

Checking uranium ore estimates . . p 100

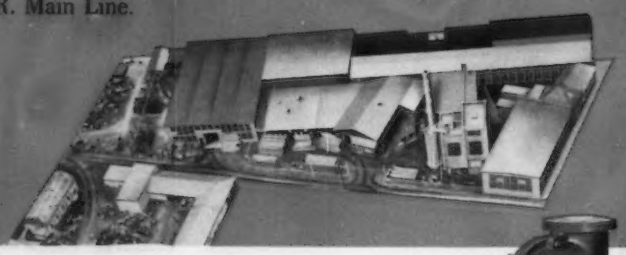
Pronto cuts its dust problems . . . . p 103

Chemical grout eases sinking . . . . p 107

Calyx drilling at the Young Mine . p 110

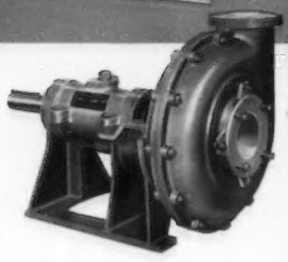
A-S-H pump headquarters in new home

Our Sales, Service and Engineering staffs are now operating in this new building in Philadelphia's suburban area of Frazer near Paoli on the Penna. R.R. Main Line.



Within a stone's throw of the new home all rubber parts are made under direct supervision in this A-S-H molding plant.

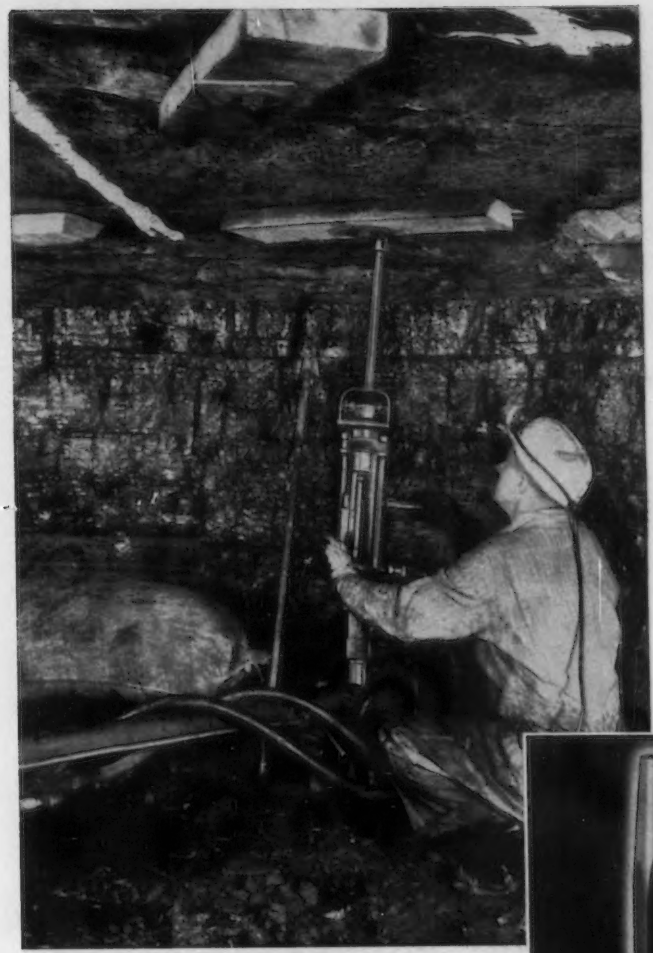
A-S-H plant at Hamburg, Penna., where Hydroseal and Centriseal pumps are expertly manufactured.



This move increases our ability to help you solve tough problems in pumping abrasives and corrosives—with ensuing savings in power and maintenance costs. There are A-S-H rubber-lined and all-metal pumps awaiting selection and application to your needs. Write us today.

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—P.O. Box 635, Paoli, Pa.
Representatives throughout the World

HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED



VACUJET

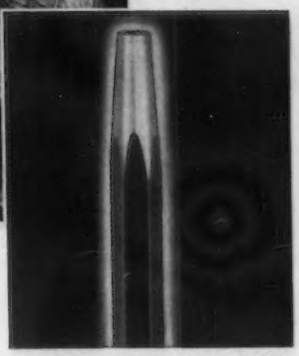
Drilling Team cuts roof bolting costs 3 WAYS!

1. VACUJET DUSTLESS STOPER CUTS OPERATING COSTS

Here's a stoper that includes its own built-in dust-removal system—gives you fast, clean drilling without any additional vacuum equipment. An ejector jet built into the drill backhead creates a vacuum that pulls all dust and cuttings down through the hollow drill steel and ejects them under positive pressure to any convenient dust collector. Even a simple canvas bag, as shown above, serves the purpose.

Because of its highly efficient ejection system, the Vacujet Stoper uses 15% less air and provides greater drilling power and speed. It's easier to set up and use, too. There are only two hose connections to the drill—the compressed air line and the dust discharge hose.

If you haven't tried the Vacujet, you don't know how simple and economical dry dustless drilling can be. Ask your I-R engineer for complete information, or send for Bulletin 4195.



2. CARBURIZED DRILL STEEL CUTS ROD COSTS

Ingersoll-Rand *carburized* drill steel is specially treated to provide exactly the right combination of hardness and core toughness to withstand millions of impacts without molecular fatigue. On job after job, these super-steels have outlasted ordinary alloy steel rods by two-to-one! This means less steel to handle—less time out for rod replacement. Rods are easy to recondition, too—simply cut off shank or grind Class B taper for bit end.

3. NEW "one-use" CARSET BITS CUT BIT COSTS

Here's a long-life, heavy-duty tungsten carbide insert bit that can be drilled to destruction *without any resharpening*. One Carset bit will outlast 16 to 20 "one-use" steel bits—at a saving of up to $1.60 per bit cost alone. More important, the time saved changing steel bits is converted into drilling time. On typical applications, "one-use" Carset bits are drilling 235 ft. where steel bits lasted 12½ ft.—and 350 ft. where steel bits were completely used up in 17 feet of drilling. Available in 1½" and 1⅜" sizes, with Class B taper connection. No shims needed.

Ingersoll-Rand

5-970

11 Broadway, New York 4, N. Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

MAXIMIX RUBBER PROTECTED

ENGINEERING AND MINING JOURNAL

93rd YEAR OF PUBLICATION

NOVEMBER 1959

VOL 160 — NO. 11

Behind the By-Lines . . 4
E&MJ Outlook 17
Markets 22
New Products Digest . . . 41
Operating Ideas 116
Personals 182
This Month in Mining . . 18
Washington Impact . . . 20

The Chinese Had Two Words For It 81

Brown Iron Ores, Salzgitter's Basis for a Second Ruhr 82

Upgrading Salzgitter Ores . . . . . John B. Huttl 87

Graphic Locator Speeds Mapping 93

Pachuca Goes After Its Old Tailings 94

Manganese Responds to Dithionate 96

USBM Charts Segregation Process 98

Comparing Ore Estimates with Production in Salt Wash Sandstone . . Robert J. Wright 100

Pronto Cuts Dust at Dumps and Ore Passes . . . . . Harold Pudney and Thomas Kneen 103

Chemical Grout Solves Sinking Problem at Meramec Shaft . . . . . Lee Bilheimer 107

How the Young Mine Cored an Air Shaft . . . . . Paul Ziemke 110

Man in the News: Miles P. Romney 112

Patents, Processes and Processing 120

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B.F.Goodrich

Hose helps dig a ditch that will detour a river

B. F. Goodrich improvements in rubber brought extra savings

THOSE machines are drilling holes for dynamite charges to blast out rock. When the job is done, a mighty river will take a detour down this newly formed channel. Power for the machines comes from compressed air, carried by hose. But on jobs like this, rubber hose used to go to pieces in no time.

When heat from the compressor got into the hose, it would harden the rubber, breaking it into loose, gummy particles that clogged the machine, put it out of action.

B.F.Goodrich engineers went to work on the problem. By adding, subtracting and changing proportions of rubber, they found a special compound for the hose that stands heat without scorching or hardening.

Hose lined with this new rubber was made and put to work. On jobs where air hose used to go to pieces in weeks, B.F.Goodrich hose now lasts months, even years.

Thousands of feet of B.F.Goodrich air hose are in constant use on this job. It's been doing dozens of different jobs, and lasting longer doing them, even though it's dragged over rough, jagged rocks, soaked in water, sometimes battered by flying pieces of rock.

Your B. F. Goodrich distributor has the exact specifications for the B.F.Goodrich air hose described here. And, as a factory-trained specialist in rubber products he can answer your questions about all the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-744, Akron 18, Ohio.*

B.F.Goodrich *industrial rubber products*

Behind the By-Lines...

As a reader of omens and trends, we rank somewhere below the late LITERARY DIGEST. Therefore, we list the following items, culled from a number of sources, and leave the interpretation to some as yet unborn archeologist, political scientist or mining editor:

"Just as the (Federal) farm program was necessary to maintain the existence of the farmer—that bulwark of rugged American individualism—so it is necessary to nurture and protect shareholders . . . The first proposal would be that no purchaser of a common stock need ever sell it below cost. He would have the privilege, in case of emergency, to borrow his cost (parity price of the stock) from the Government. If his stock didn't go up—in say a year or two—the loan would be forgiven and the Government would own the stock. . . . The stocks the Government got stuck with, or acquired under the loans would be stockpiled (pun unavoidable). The Government would either sell them at a propitious time or give them away to worthy institutions such as its own pension funds, the Smithsonian Institute, etc., or the underpriveleged in our country or abroad . . . (The U.S.) might even stockpile common stocks as a national defense measure and pay corporations not to issue new stocks, just as it pays farmers not to produce.—from ARIZONA PROGRESS, published by the Valley National Bank of Phoenix.

Butte Copper & Zinc Co. a producer of manganese, and Jonathan Logan, Inc., a leading producer of women's apparel, are merging. With the purchase, the dress manufacturer will acquire a listing on the New York Stock Exchange and the flooded Emma mine. It is believed that more will be made of the former than the latter.—from E&MJ's Butte, Mont. news correspondent.

Three days prior to the earthquake which shook Yellowstone Park and neighboring parts of Montana several weeks ago, all the water fowl in the area departed for parts elsewhere and did not return until several days following the tremors, according to park rangers. We've been spending some time wondering if, were genus americanus not so bloomin "civilized" and insensate, might he have been able to feel it coming, too?

Three young skin divers, working in 20 ft of water in the North Yuba River, near Downieville, Calif., came up with $900 worth of nuggets in two days work. The young men found one nugget, part quartz and part gold "as big as a baseball" and lesser nuggets worth $50 per ounce as specimen or jewelry gold—THE MINING RECORD, of Denver, Colo.

Add: Good Neighbors. Pan American Sulphur Co., which saw the church, most of the buildings, and the homes of its employees in nearby Jaltipan, Tehuantepec, Mexico, destroyed in the August earthquake, is pitching in.

Harry C. Webb, president of Pasco, has organized the Jaltipan Fund, which will support the reconstruction of the village, and has asked stockholders of the company to contribute. The company itself went right to the job as soon as the dust had settled, with all available personnel and equipment. Pasco has no legal responsibility for the village, it merely feels the duty of a good neighbor.

Our Mr. Huttl (above) is presenting the cover story this month. It's the first of several you'll be receiving on modern mining in Europe.

Mr. Huttl, with Mrs. Huttl happily in tow, spent several weeks "on the Continent" this past summer, visiting major mining properties, talking to leading mining men, and even chatting with a couple of East German mine officials, brought across the border for the occasion. Very pleasant visit, he says.

The first entry from our Associate Editor's travel diary starts on p 82, the story of the Salzgitter mine, a producer of brown iron ore.

In it, you'll find complete technology of the deposit and the huge potential for European industry which is signifies.

On p 87, with his usual thoroughness, Our Mr. H goes into the upgrading problems and solutions at the Salzgitter mine. We doubt that you'll find a more complete and exhaustive flowsheet anywhere this side of the mine engineer's office back in Germany.

And, of course, there's more. If exploration is your major field, we'd like to suggest a lengthy stop in the area around p 93, where the graphic locator is studied in detail.

Or, if mineral processing takes up most of your time, check the Pachuca story on p 94, the manganese processing item on p 96 or the segregation article on p 98.

Mining practice, exclusive of the Salzgitter story, is the theme on p 103, where two of Pronto Uranium's engineers describe their successful efforts to cut dust at ore dumps and passes. Then, on to the chemical grouting story at St. Joe, which opens on p 107, and the sinking of a ventilation shaft at American Zinc Co., available on p 110.

Our old friend the beachcomber has been complaining about the high cost of everything again. This time, it appears, he's mostly concerned with the weakened state of our currency. His latest communique, to wit: "What this country needs is a good five-cent nickel."

SPECIAL REPORT TO CATERPILLAR OWNERS

CAT CATERPILLAR

Parts you can trust.
Dependable round-the-clock service.

CATERPILLAR PARTS ASSEMBLY EXCHANGES LET YOU
TRADE DOWN TIME FOR MORE GO TIME

Here's news about the time-saving, money-saving plan offered by your Caterpillar Dealer. It works this way:

1. Place your order for a parts exchange assembly that is available from dealer stock.
2. Remove your worn assembly and install the reconditioned unit.
3. Send your machine back to work and return the worn unit for credit.

Do-it-yourself repairs to parts assemblies must be weighed against earning losses. What would your equipment earn for you *during the extra time* it takes to repair parts assemblies? You can eliminate earning losses of this type and still pay no premium. Your equipment can actually be making money for you, when otherwise it would be down.

Cat assembly exchange units are guaranteed by your Caterpillar Dealer and can be ready to go on just as soon as the worn assembly is off. The cost? The cost compares favorably with the actual cost had you done the repair work yourself—often less because of the availability of special equipment and serviceman's skill in your dealer's shops.

You can exchange with confidence. When you purchase a Caterpillar Exchange Assembly, you can be sure it's been reconditioned by trained experts using authorized techniques, and only *genuine* Caterpillar parts are used. Every assembly exchange item is backed 100% to be in first-class condition.

Any way you look at it, Cat Parts Assembly Exchange is a good deal. You get a dependable, guaranteed exchange unit at approximately the same cost had you done the job yourself—and the time saved can be converted into cash by having your machine working and earning. Contact your dealer today for his list of Parts Assembly Exchange Units and prices.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

EQUIPMENT RENTAL AVERAGES DURING 1958*
as compiled by Associated Equipment Distributors

CRAWLERS	PER DAY DIRECT DRIVE	PER DAY TORQUE CONVERTER
D9	$296.00	$386.00
D9 w/No. 9A Dozer	367.00	457.00
D9 w/No. 491 Scraper	497.00	507.00
D8	211.00	330.00
D8 w/No. 8A Dozer	270.75	398.25
D8 w/No. 463 Scraper	366.00	485.00
D7	142.00	
D7 w/No. 7A Dozer	188.25	
D7 w/No. 435 Scraper	265.00	
D6	107.00	
D6 w/No. 6A Dozer	148.50	
D6 w/No. 60 Scraper	179.75	
D4	74.75	
D4 w/No. 4A Dozer	109.50	
D4 w/No. 40 Scraper	113.40	

MOTOR GRADERS	PER DAY
No. 14	$138.00
No. 14 w/Scarifier Attach.	149.00
No. 12	117.00
No. 12 w/Scarifier Attach.	125.75
No. 112	93.00
No. 112 w/Scarifier Attach.	110.85
WHEEL TRACTORS w/2-WHEEL SCRAPER	
DW21-No. 470	$382.00
DW20-No. 456	482.00
DW15-No. 428	205.00
TRACTOR LOADERS, FRONT END LOAD and DUMP	
No. 977	$199.00
No. 955	108.00
No. 933	85.75

*Figures are national average rates and in no way reflect the going rate in any area, and cannot be so used. Actual rental costs vary depending on local practices and conditions.

SERVICE TIP

BEFORE you begin to tear down your equipment to remove a parts assembly, check with your Caterpillar Dealer on availability and delivery. The big advantage of Parts Assembly Exchange is in having the reconditioned unit ready to go on as soon as the worn one is off.

CATERPILLAR

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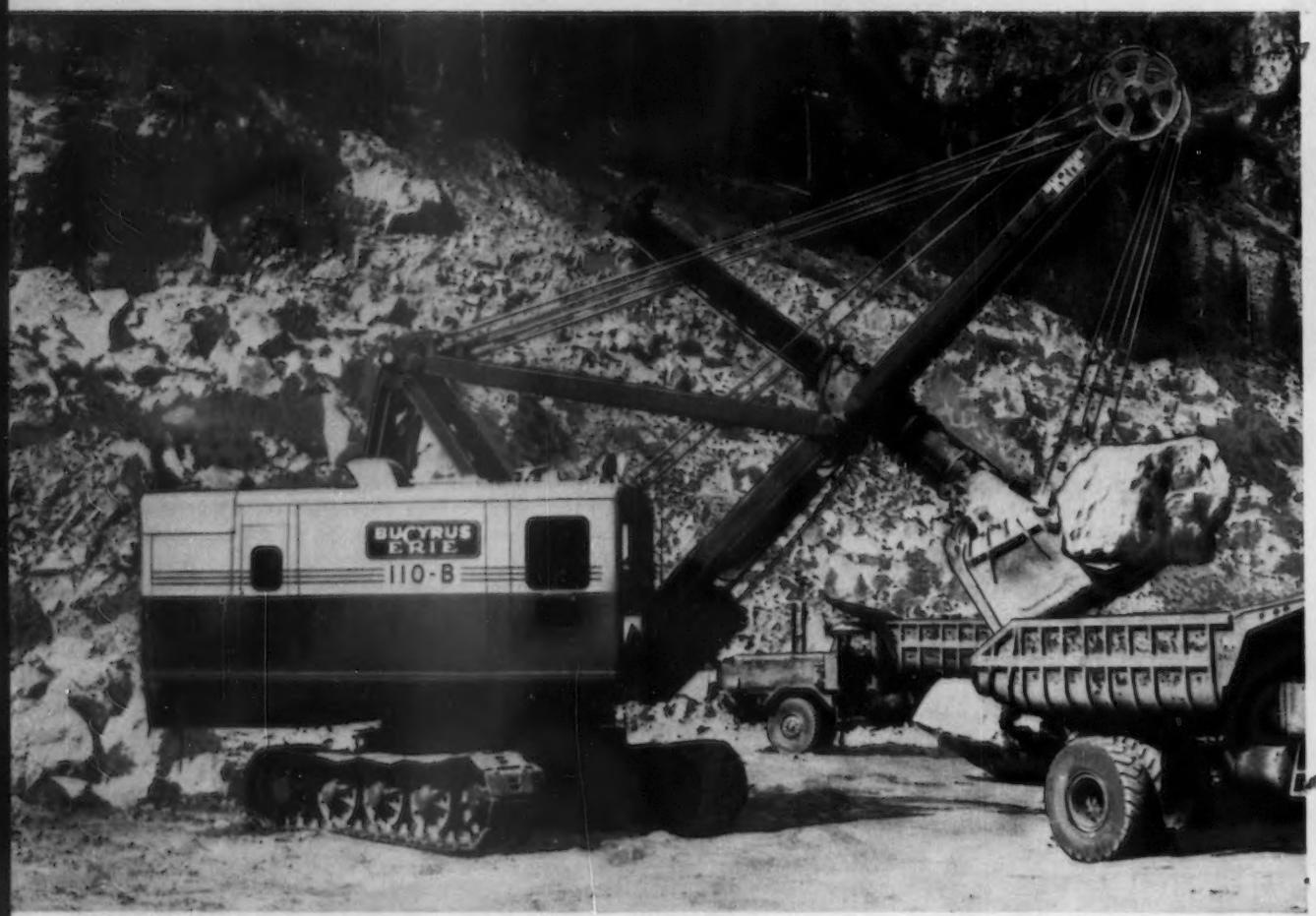
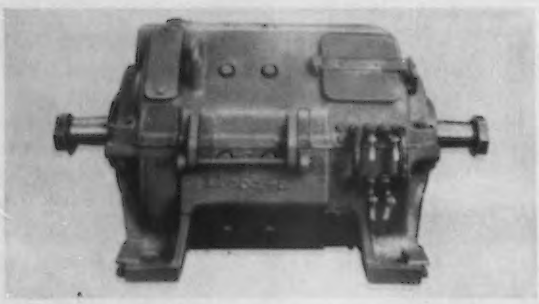
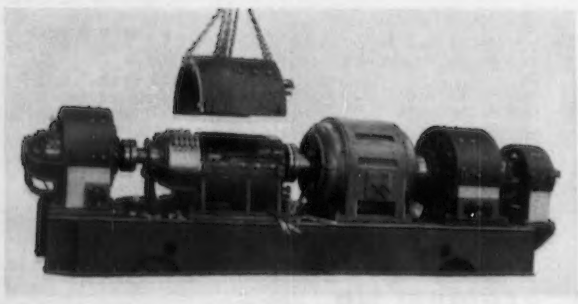
General Electric D-c Drives Give . . .

MORE DIGGING POWER AND



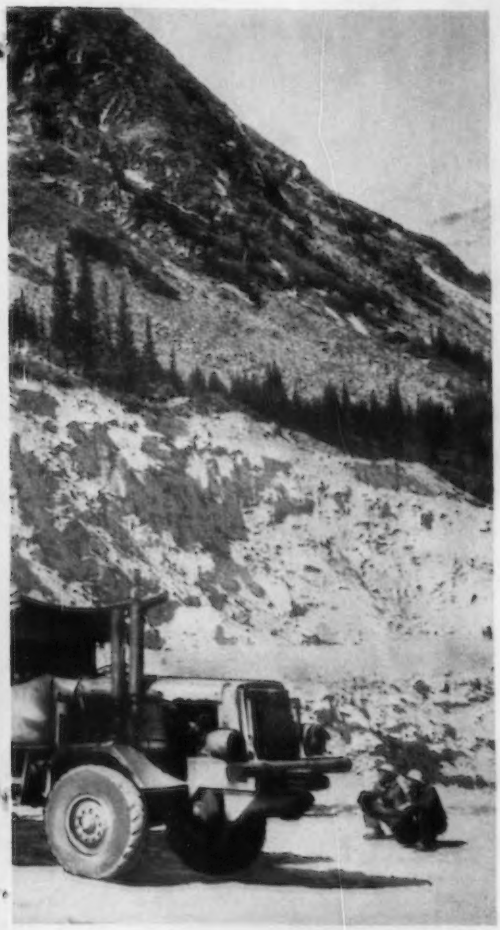


G.E.'s high torque, low inertia direct-current MD motor has large air gaps and advanced insulation system for temperature stability, greater power, and efficiency.



Maximum direct-current output to handle heavy loads is provided by reliable General Electric motor-generator set designed especially for rugged shovel service.

CONTROL AT THE BUCKET



You can move more tonnage faster at less cost with General Electric's powerful, fast responding d-c shovel drive. G.E.'s complete line of rugged shovel motors, reliable motor-generator sets, advanced control and excitation components are *system designed*, job tailored in cooperation with leading shovel builders to give:

More passes per hour, the result of high speeds at light loads and fast power reversal.

More working hours per shift. Low speeds at heavy loads reduce impact, giving reduced downtime and maximum output.

More production. Control system provides faster response of all motions, improved performance, reduced operator fatigue.

Lower power costs. Power returns to the line during stopping or lowering, results in minimum energy and demand costs.

From research to field service, General Electric helps you get optimum performance and economy from your shovel operation. Using computers and other modern tools for analytical work, G-E research and product development personnel evaluate existing and new drive systems, assure continual progress in General Electric d-c shovel drives.

Helping you keep pace with improved shovel drive technology, experienced G-E design and application engineers utilize most advanced materials and components in your General Electric drive system, help you get maximum benefit from your shovel investment.

General Electric d-c drive equipment is thoroughly tested at the factory and inspected in the field by qualified engineers who work closely with the shovel manufacturers.

To assure minimum downtime and maximum performance of electrical components, G.E. maintains one of the nation's most extensive systems of service facilities.

More than 50 service shops offer three-way 'round-the-clock' assistance: repair and modernization of old equipment, help in setting up a modern Productive Maintenance Program, and emergency downtime service.

For more information about General Electric d-c shovel drives and G.E.'s extra value services, call your nearby G-E Apparatus Sales Office, or write Section 827-2, Direct Current Motor and Generator Department, 3001 East Lake Road, Erie, Pennsylvania.

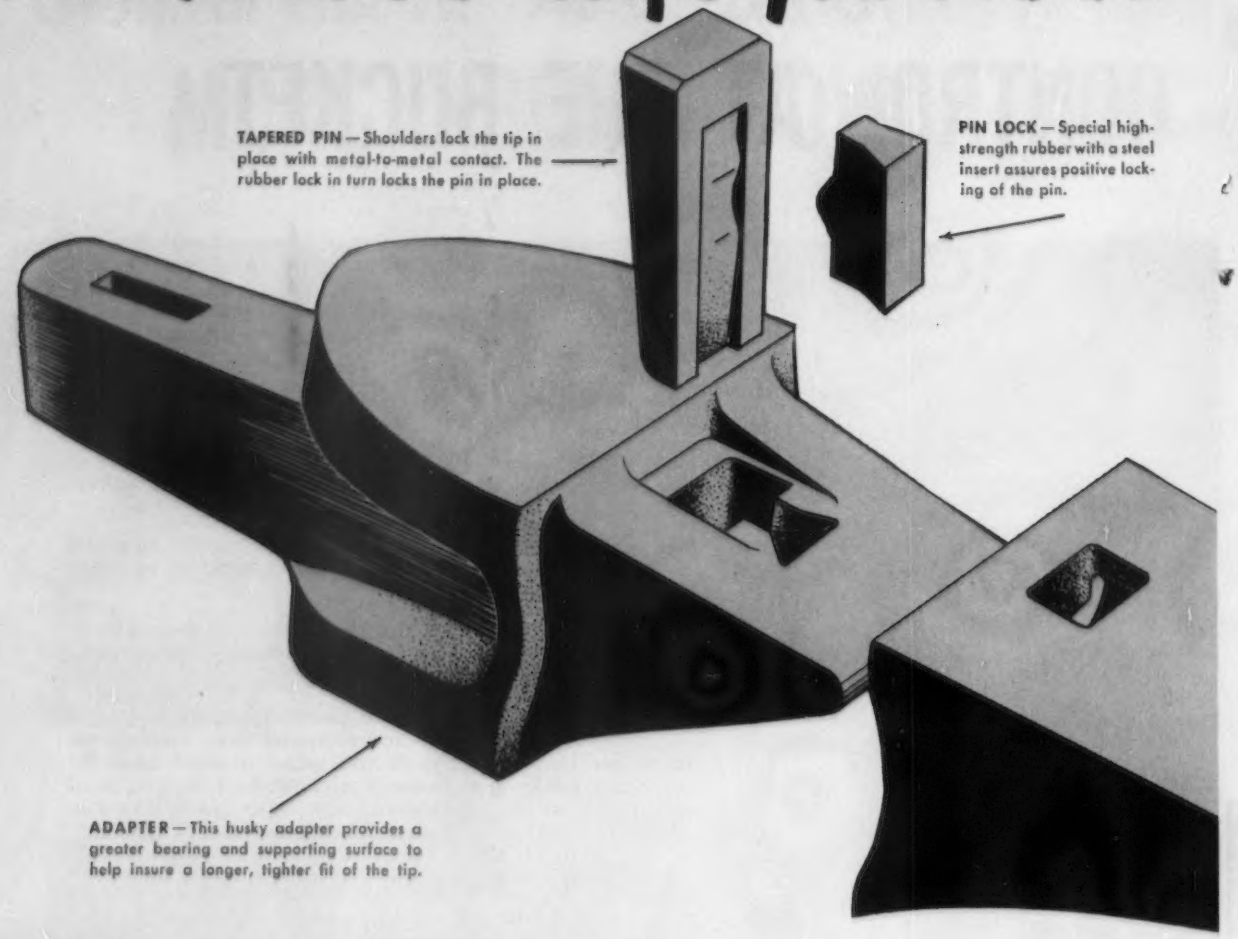
General Electric engineers are available to help solve your electric drive problems, your distribution and mill requirements.

DIRECT CURRENT MOTOR & GENERATOR DEPT.

GENERAL ELECTRIC

ERIE, PENNSYLVANIA

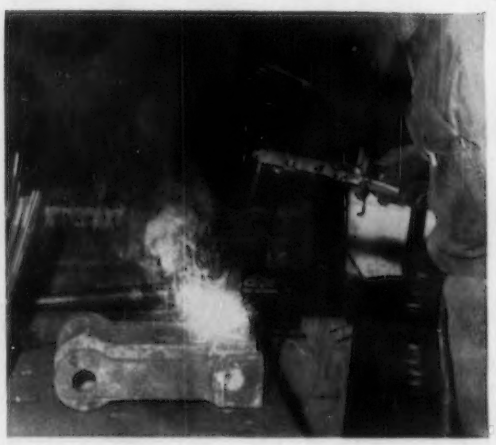
How AMSCO helps you MOVE


TAPERED PIN — Shoulders lock the tip in place with metal-to-metal contact. The rubber lock in turn locks the pin in place.
PIN LOCK — Special high-strength rubber with a steel insert assures positive locking of the pin.
ADAPTER — This husky adapter provides a greater bearing and supporting surface to help insure a longer, tighter fit of the tip.

UNBEATABLE TEAM!

AMSCO CAST MANGANESE STEEL DIPPERS

Installed as original equipment on many leading makes of power shovels. Cast of manganese steel—"the toughest steel known"—a material which provides as much as a ten-to-one advantage in lasting power over other steels, under the abuse of severe impact and abrasion. Sizes from ¾ cu. yd. to 9 cu. yd. capacity. See your power shovel distributor, or write us for booklet . . . "Amsco Manganese Steel Power Shovel Equipment".

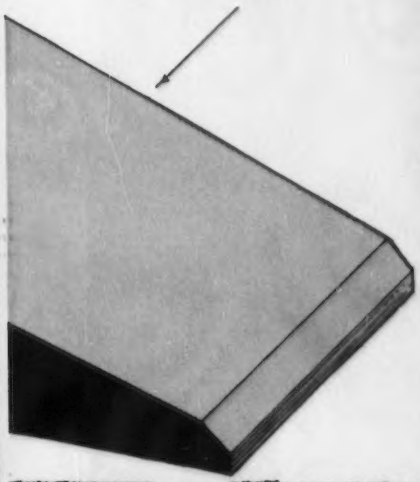


MORE TONS PER DOLLAR

AMSCO Simplex 2-Part Reversible Dipper Tooth

- **EXTENDS DIGGING LIFE**
- **STAYS SHARP**
- **EASY TO REPLACE**

REVERSIBLE TIP—Enables you to get longer digging life while maintaining sharpness.



Now you can save hours of costly shovel downtime... by using this new Amsco Simplex 2-Part Tooth.

Simplex tips are quickly reversible to give added tip life while retaining sharpness. And when teeth eventually become worn, just knock out the retaining pin and replace with a new tip.

Simplex adapters fit this new 2-part tooth to *any* Amsco dipper or backhoe. And because Amsco makes both dippers and dipper teeth, you can be sure of proper fit between the adapter and shovel lips.

Cast of a new alloy especially developed for this service, the Amsco Simplex design is backed by over 50 years of experience in producing dippers and dipper teeth for the most rugged digging conditions.

Ask your power shovel distributor to supply you with these extra-long-wearing Simplex 2-part teeth... now!

Write us for complete descriptive bulletin on Amsco Simplex teeth, giving information on sizes and types available.

AMSCO HARDFACING FOR BUILD-UP AND REPAIR

Add extra service life at low cost to dippers, dipper teeth, hammers, augers, etc.... with Amsco Hardfacing. Complete line of hardfacing electrodes available through your Amsco welding distributor. Or write us for condensed catalog and price list on "Amsco Hardfacing Alloys".

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

Other Plants in: Denver • Los Angeles • New Castle, Dela. • Oakland, California • St. Louis

In Canada: Joliette Steel and Manitoba Steel Foundry Divisions

Welding products distributed by Canadian Liquid Air Co., Ltd.

THE RIGHT BIT.. FOR YOUR JOB!

And it's there ON TIME!

With plants located throughout the world, Christensen meets your drilling requirements with the right bit, on the job, in time —

RESETTING — Your used diamonds can be reset in the same bit style or type. Your bit style can be changed to meet any new drilling requirement. You are billed only for the new diamonds, plus a nominal fee for setting. Regardless of type or manufacture of core barrel presently in use, we can complete your order of diamond bits or shells to fit its specifications.

TIME — Your new style or reset bit can be shipped within five working days after your order has been received.

CORE BARRELS — For standard equipment listed in our catalog SD 507, a maximum of two days is required before shipment, and frequently shipment is made the same day your order is received. Custom designed core barrels manufactured to any size and specification — let us quote you price and delivery.

MISCELLANEOUS DRILLING SUPPLIES — As a convenience to our customers, drill rod, casing, handling and fishing tools are also available.

The combination of Christensen's experience and unequaled service assures you of "less cost per foot", regardless of job location.

Call Christensen today!

Diamonds Mean, "Less cost per foot."

CHRISTENSEN DIAMOND PRODUCTS

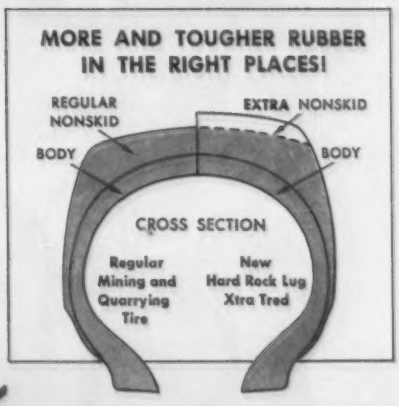
1937 SOUTH SECOND WEST • SALT LAKE CITY, UTAH

EXTRA TREAD TO TAKE IT WHERE THE GOING'S EXTRA TOUGH!

NEW HARD ROCK LUG XTRA TRED

Specially Engineered Tire for Mine and Quarry Work

More and tougher rubber in the right places—exclusive Triple-Tough 3-T Nylon Cord to back it up. That in a word is why this great new Goodyear tire tops its class. Specifically designed to take the hard knocks, the Hard Rock Lug Xtra Tred—with 18% more tread rubber, reinforced lugs, bonus shoulder heft and huskier sidewalls—stands up under tough punishment that kills lesser tires in short order. And thanks to 3-T Nylon Cord, greatest tire saver in 24 years, cuts, bruise-breaks and blowouts are reduced to an all-time low. Get full details from your Goodyear dealer now. Goodyear, Truck Tire Dept., Akron 16, Ohio.



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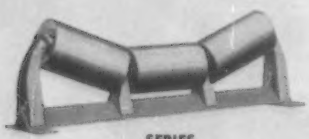
Xtra Tred—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

SERIES
5000
For intermittent or light service, fine or small-lump materials.

SERIES
6000
For intermittent operation, medium capacities or continuous handling of lightweight material.

SERIES
7000
For continuous operation, high capacities, heavyweight, abrasive materials.



SERIES
8000
For continuous operation, higher capacities, heavier-weight, abrasive materials.

SERIES
9000
For continuous service, highest capacities, heaviest and coarsest materials.

NOW! No wasteful over or under-engineering

In these 5 series—LINK-BELT has an exact idler for every type of belt conveyor application

Here is industry's most complete belt conveyor idler line, by far. Ranging in application from light or intermittent service to continuous heavy-duty operation, Link-Belt idlers are made in both 20° and 45° troughing for a broad range of belt widths—with rolls of various diameters, materials and coatings. This broad coverage eliminates wasteful over- and under-engineering . . . permits "pin-pointing" that results in substantial savings in purchasing and maintenance. For further information on over 630 types and sizes of Link-Belt idlers, contact your nearest Link-Belt office or authorized stock-carrying distributor. Look under CONVEYORS in the yellow pages of your phone book. Or write for our new Catalog 2716.

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LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

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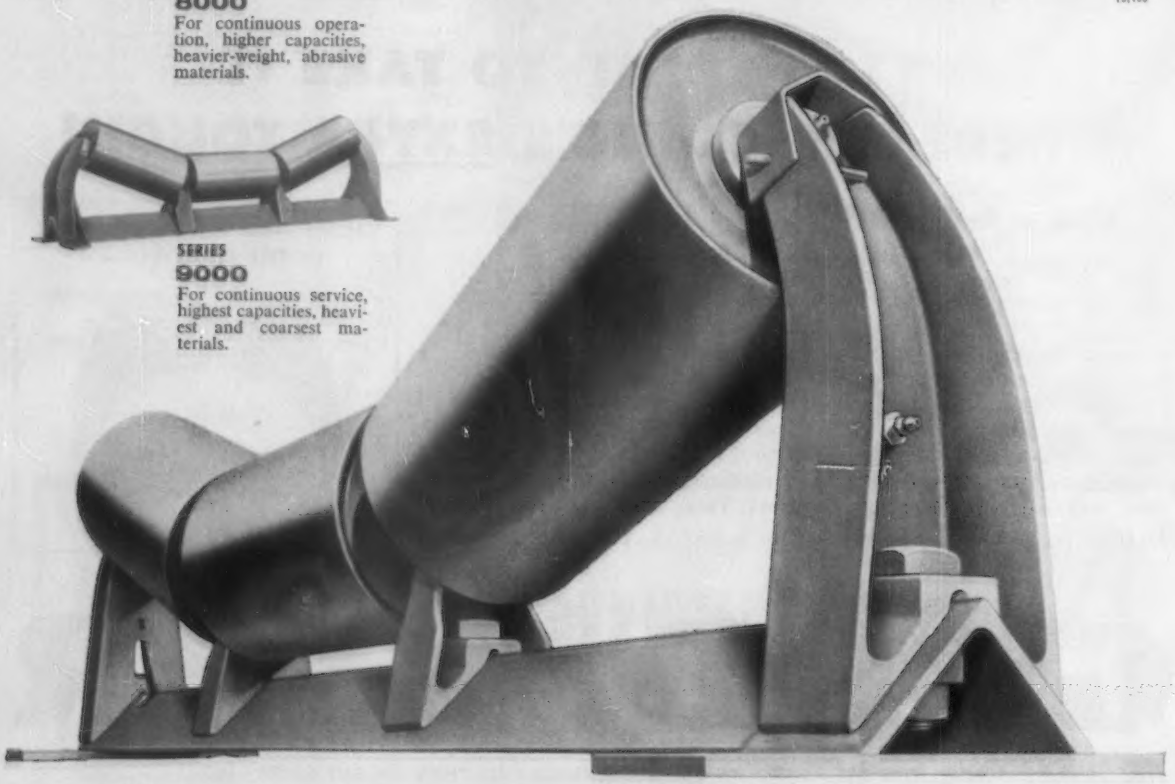
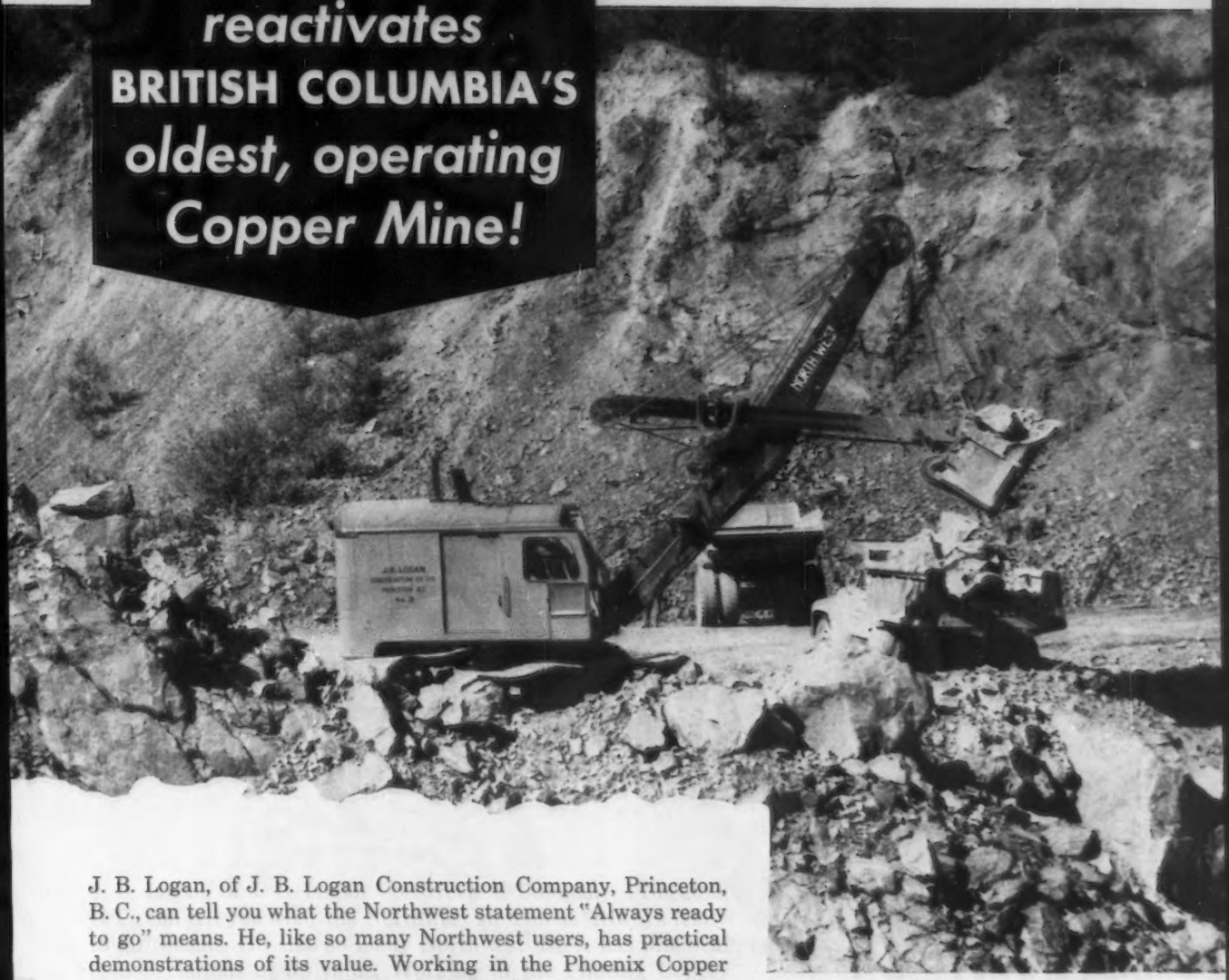


NORTHWEST
reactivates BRITISH COLUMBIA'S *oldest, operating Copper Mine!*



J. B. Logan, of J. B. Logan Construction Company, Princeton, B. C., can tell you what the Northwest statement "Always ready to go" means. He, like so many Northwest users, has practical demonstrations of its value. Working in the Phoenix Copper Co., Ltd. pits at Grand Forks, B. C. his Northwest No. 3 has loaded out over 2,000,000 tons of copper ore with only 16 hours down time. It is dependability like this that cuts mine production costs, and it is part of the reason why J. B. Logan now owns his third Northwest.

Northwest design begins from the bottom up for rock work—cast steel machinery bases and machinery side frames, crawlers that give self-cleaning action and more easily negotiate tough going, the Cushion Clutch that eliminates shock overloads to parts under power, the "Feather-Touch" Clutch Control for easier handling, Uniform Pressure Swing Clutches that take the jerks and grabs out of swinging, the Northwest Dual Independent Crowd that utilizes force most other independent crowd shovels waste—these are but a few of the advantages that Northwest Rock Shovels bring you. And remember, if you have a *real* Rock Shovel you never have to worry about output in *any* digging. With the advantages and proved performance of a Northwest, it's no wonder Northwest owners come back!

CRANES
SHOVELS
DRAGLINES
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TRUCK CRANES

3/4 to 3 Cu. Yd. Capacity

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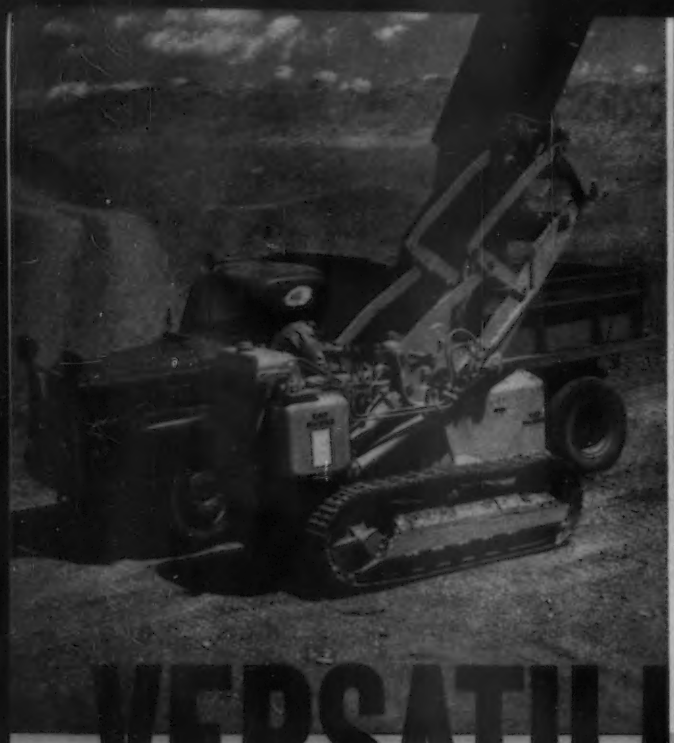
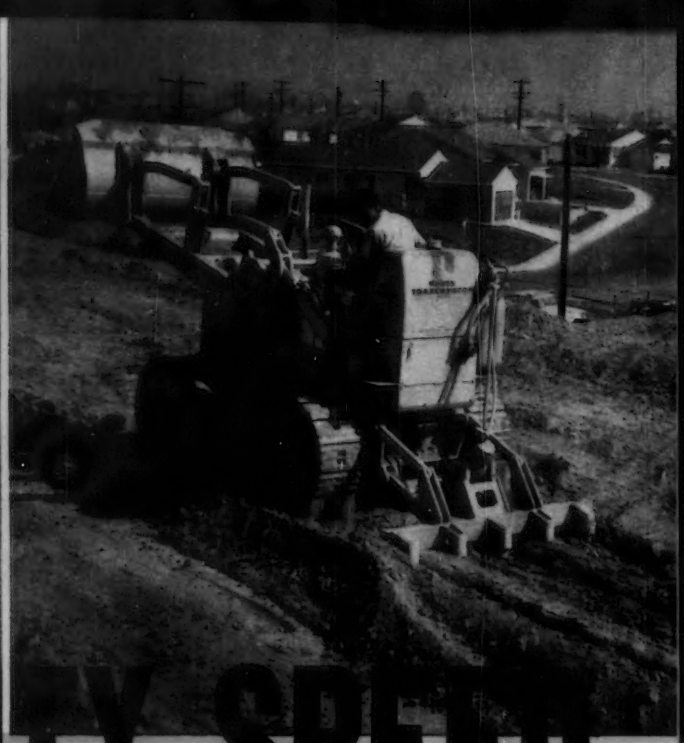
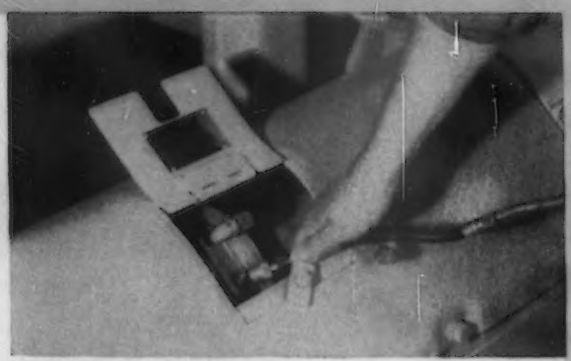


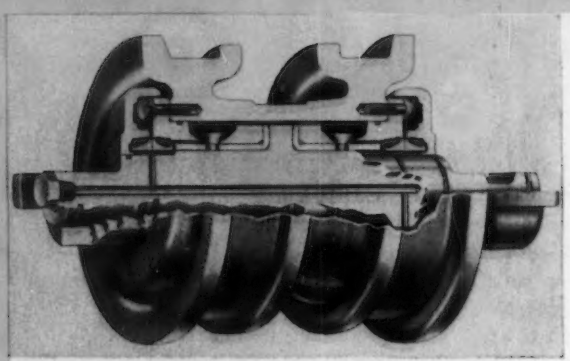


VERSATILITY SPEED

ADD UP TO TOP PRODUCTION

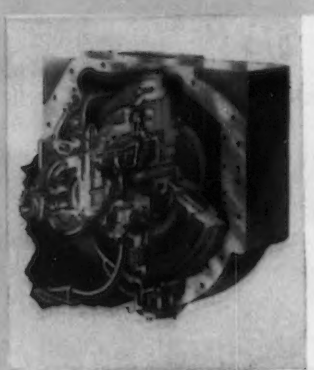


HYDRAULIC TRACK ADJUSTERS standard on the No. 977 and No. 955 —optional on the No. 933. An ordinary grease gun is all that's needed to adjust tracks. Just open the inspection door and apply a few strokes. The hydraulic cylinder does the rest.



LIFETIME LUBRICATED ROLLERS. They need no lubrication servicing until rebuilding. Heat-dissipating oil lubricant is retained by dirtproof floating-ring seal. Eliminate on-the-job roller lubrication. Keep machines on-the-go for longer periods of time.

SMOOTH-FLOW BUCKET CONTROL LEVER. The inside lever is pulled back, lifting the load. It locks in this position until it is kicked out at maximum height by the lift cylinder and linkage. After dumping, both levers are pushed forward. The bucket lowers but only tilts back to an adjustable, preset digging position. Linkage then kicks the outside lever, stopping the bucket tilt.



EXCLUSIVE CATERPILLAR OIL CLUTCH . . . the most advanced clutch design ever offered. Provides up to 2,000 hours without adjustment. This is equal to about 12 months of "adjustment-free" operation. And because wear rate of clutch facing is so slight, down time for clutch repair is almost eliminated.

DEPENDABILITY

IN A TRAXCAVATOR

WHATEVER THE JOB . . . whatever the conditions . . . there's a Caterpillar-built Traxcavator to take charge. Advance design has given this machine a reputation for speed . . . efficiency . . . low operating and maintenance costs. For this is a digging and loading tool; not a tractor attachment.

The line is complete. You get top production from three Traxcavators . . . the No. 933—52 HP, 1⅛ cu. yd. bucket; the No. 955—70 HP, 1½ cu. yd. bucket; the No. 977—100 HP, 2¼ cu. yd. bucket. And there's a complete range of quick-change attachments . . . special buckets, bulldozers, forks, the exclusive side dump bucket and the rear-mounted ripper.

Traxcavators are built to last. They have a heavy steel main frame, welded into a one-piece unit. Box construction track roller frame absorbs the loads and stresses of tough treatment. Lift arms are made to stand up under the strain of heaviest digging conditions.

Traxcavators give you fast action and ease of operation. Excellent stability and balance give better control of the machine. A fast hydraulic system cuts cycle time and increases maneuverability even in close quarters. Visibility is excellent. The high seat puts the operator on "top" of the work. Operator's compartment is uncluttered. Tractor controls are conveniently located for handling ease. Bucket controls are at the right armrest . . . closely spaced for dual operation with one hand.

The reliable Caterpillar Diesel Engine has a fuel-saving injection system and ability for hard lugging. Each engine is matched to the machine for power and bucket size.

All of these features pay off in top production. Let your Caterpillar Dealer help you choose the Traxcavator best suited for your job. Get production facts and figures. And ask for a demonstration.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR

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BOOST PRODUCTION AND LOWER COSTS WITH A VERSATILE TRAXCAVATOR

ENGINEER'S FIELD REPORT

PRODUCT CHEVRON PRESSURE PRIMER SYSTEM

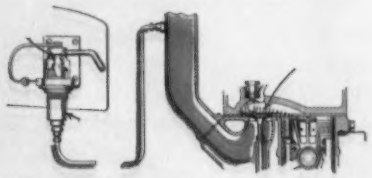
FIRM JONES-TOMKINS CO. Cougar, Washington

Special cartridge fires giant diesel in seconds

At world's highest earth-filled dam construction site near Woodland, Washington, three giant diesel shovels get immediate starts from Chevron Pressure Primer System, reports Jones-Tomkins, general contractors. System helps speed shovel's fill-borrowing operations for this $51,000,000 project. Five-year-old 4500 Manitowoc Speed Crane (above), powered by Caterpillar 350 h.p. V-12 D397 engine, operates 18 hours a day, six days a week, loading 21-yard dump trucks in just 70 seconds. Jones-Tomkins uses Standard fuels and lubricants exclusively on this job.

Chevron Pressure Primer Discharger mounted on instrument panel (left) operates satisfactorily despite heavy vibration, reports shovel foreman Henry Watson (right). "We've had absolutely no trouble with this system. The Chevron Pressure Primer System eliminates dust clogging and allows fluid to reach the cylinders quickly. It's the practical way we've found to get these rigs going."

Why Chevron Pressure Primer System assures fast starts



- Volatile Chevron Priming Fuel atomizes in induction system at all temperatures even at −65°F, no hand-pumping required.
- Pressure or weakest spark from engine fires mixture.
- Simple rugged air-tight discharger prevents Priming Fuel leakage.
- Small, fireproof, pressurized steel cartridges protect Priming Fuel from water and dirt.

For More Information or the name of your nearest distributor, write or call any of the companies listed.

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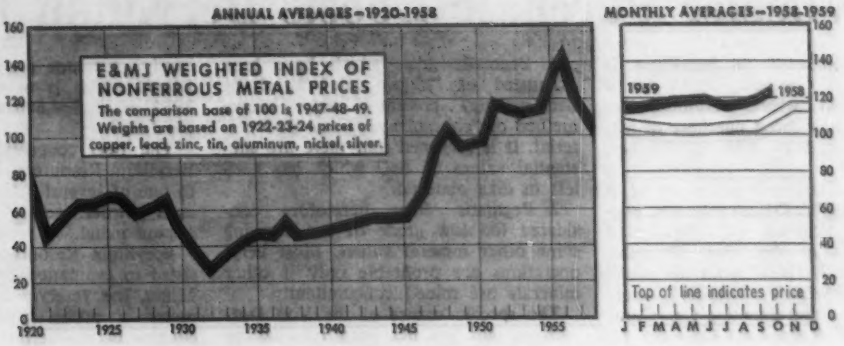
E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's metal price index moved up sharply from 122.5 for September to 126.0 for October. The squeeze in copper supplies caused by strikes was the principal factor. Higher zinc prices toward the end of the month were also responsible for the increase.

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AT HOME

Minnesota's Tax Commission will make a study of the growing development of iron ore plants in the Quebec-Labrador area. Total value of iron-ore projects completed or planned in this area of favorable Canadian investment climate will approximate $1-billion.

Thomas Ware, president of International Minerals & Chemical Corp., told stockholders recently that at the current rate of increased use of nitrogen in the firm's products, the volume by 1964 would "be sufficient to justify production of nitrogen for our own use." He reported that a similar situation exists in sulphur.

Coal industry spokesmen are wooing metal mine producers with an eye toward presenting a united front on mutual issues at the next session of Congress. The American Mining Congress, under new president Raymond Salvati, of Island Creek Coal Co., is now financially backed 55% by coal, up from 35% a few years ago.

Agitation for a Secretary of Mines, with full cabinet status, is growing in top mining circles. Conflict of interests, many opposed to mining, under the umbrella of Interior Department is the chief reason for the move.

•

LABOR

Despite hopes that the labor reform bill passed last summer would solve major legislative problems, Congress will have to tackle the Taft-Hartley Law when it convenes in January to revise the law's strike-stopping injunction processes. See p 21.

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ABROAD

Soviet engineers claim to have designed the world's largest cone crusher, one capable of crushing 4,000 metric tons per hour. The first two test units are reported to have been shipped by the Ural Machine Plant to the Central-Ural Copper Plant. Engineers are now working on designs to increase the output to 6,000 to 7,000 metric tons per hour.

Revision of Cuban mineral laws in late October threw a jolt into American mining companies developing projects on the island. See p 19.

More than 20 trade unions have agreed to cooperate with Imperial Chemical Industries, Ltd., in raising productivity and efficiency to offset increasing costs. This same willingness of labor to help management stay competitive in international markets is evident in Belgium and other European countries.

THIS MONTH IN MINING

Mt. Wheeler Purchase Boosts Beryllium Interest

INCREASING INTEREST in beryllium is being shown in Colorado, South Africa and in Nevada, where Beryllium Resources, Inc. announced purchase of Mt. Wheeler Mines, Inc. (E&MJ), October, p 130)

Beryllium Resources, made up of a group of Floyd W. Odlum interests, purchased 111 patented and unpatented mining claims in the area 47 miles southwest of Ely, Nev. from 62 stockholders of Mt. Wheeler, including American Zinc, Lead and Smelting Co., Combined Metals Reduction Co., E. H. Snyder, Allan Hoover, son of the ex-president; and James D. and Ruth Williams.

A second firm, Dynamic Metals Corp., was formed by the Odlum interests, and announced the acquisition of rights to a flotation process for beryllium ores developed by chemical engineer E. Van Dornick and metallurgist Merill MacAfee, both of Los Angeles. Van Dornick is a shareholder in Dynamic Metals.

Mr. Williams, president of Mt. Wheeler, discovered the beryllium at the Nevada property in February 1959, confirming values averaging 75% BeO in presently estimated reserves of between 100,000 and 200,000 tons of ore.

The district had been primarily a tungsten producer since 1950. In earlier days, some mining of the exposed lead-silver-zinc fissures in the district had been carried out.

Between 1950 and end of 1958, some 8,200 ft of drifts and tunnels had been completed. A program costing an estimated $800,000 and supported in part by DMEA funds was carried out in the property in search for and development of tungsten. It is Mr. Williams' opinion that BeO values are largely in the tungsten zone where some 3,000 ft of drifts and cross cuts were driven.

Bruce Odlum, son of Floyd B. Odlum, Atlas Corp., chairman, announced a two-fold program involving Beryllium Resources and Dynamic Metals.

Beryllium Resources under direction of Dr. Norman C. Williams, Salt Lake geologist, will drive some 2,000 ft of exploration tunnel and drift following 5,000 to 10,000 ft of long hole drilling.

Dr. Williams also will complete a mineral assemblage of the properties and the BeO deposit some 2500 ft underground in Mt. Washington district. The workings are served by the Pole Creek adit where the original BeO mineral was found.

Meanwhile, Dynamic Metals will begin a detailed study of application of the Von Dornick-MacAfee reagent for flotation of the ores. Objective of flotation is to up-grade to minimum of 10 to 11% BeO.

In addition to the potential in the large non-pegmatic deposits at Mt. Washington district, the selective flotation patents held by Dynamic Metals also will be applicable to:

1. Pegmatic dikes which have been exhausted of "high grade" beryl by hand-picking, presently only known method of "concentrating" raw BeO material. It is reasoned that there are substantial values of BeO which has been left in dike material.

2. Pegmatic dikes heretofore considered too low grade or not carrying some other mineral values. Most beryl operations are profitable only if other minerals are mined concomitantly.

The specific nature of the Von Dornick reagent has not been released by principals in the venture.

J. Bruce Clemmer, head of the Salt Lake experiment station of the U.S. Bureau of Mines, has completed considerable work toward flotation or separation of the ores at Mt. Washington district.

The Kennecott Research Center at Salt Lake City has concluded work in mineralogical evaluation of the BeO at Mt. Washington, too.

The U.S. Bureau of Mines in last year has assigned several persons to research and investigations directed at discovery or development of non-pegmatic BeO deposits.

Beryllium has been listed by some authorities as one of the few remaining "strategic" metals very much desired by the United States. The metal has wide application as a moderator in gas-cooled nuclear power reactors; in space and rocket assignments as a pure metal and as an alloy of other metals; in industrial metals as an alloy.

In the last month's story on the Odlum group's move, it was incorrectly stated that "there are no incentive purchase-programs in operation." There is an incentive purchase program being administered which is to operate until June 1962 or until 4,500 dry short tons are purchased.

EXPLORATION portal at the Mt. Wheeler mine is 47 miles southwest of Ely. A new process will float the ore.

The BeO concentrates developed by Beryllium Resources, Inc. would be sold to one of several refiners for production as a powder used in alloying and as a a pure metal.

Beryllium Resources Inc. will be assisted in evaluation of the Mt. Wheeler Mines, Inc. reserves by use of a berylometer—a probe similar to a Gieger counter in that it gives readings on ore values. (This is accomplished by use of an isotope of antimony which emits gamma rays. The gamma rays excite the beryllium into giving off neutrons. The rate of neutron emission is correlated to the ore grade.)

(Beryllium ores and concentrates have none of the toxic qualities existing in pure beryllium metals.)

If the reserve analysis and amenability tests are passed by the BeO ores in the Mt. Washington district, Beryllium Resources Inc. will establish beneficiation operations at the district.

Bruce Odlum said the sales contract with Mt. Wheeler involves a commitment running over a 11 month period with payment being made over a three year term. In return, Mt. Wheeler stockholders will deliver a certain pro rated percentage of stock held each three months. On or before Aug. 15, 1960, Beryllium Resources, Inc. must make a final commitment to buy all of the Mt. Wheeler shares, Odlum said.

In Colorado, the Boomer mine in Park County is a major U. S. beryl producer. The company also owns 45% of the Blue Jay mine and the four Blue Jay claims immediately adjacent to the Boomer on the east, south and southwest.

The Boomer-Blue Jay beryl deposits are viens (non-pegmatite) carrying ores of Cu, Pb, Ag and Mn. High grade ores averaging 10% BeO are found in lode-ore vein deposits and require little or no handling other than loading and shipping by truck to the U. S. Government buying station at Custer, South Dakota.

Total production of the Boomer Mine up to February of this year, for a period of approximately 24 months, was 485 tons of high-grade ore averaging 10.15 per cent BeO and $464 per ton; dump material added a further 98 tons of 3.21 per cent BeO at $100 per ton.

In South Africa, a countrywide survey of beryllium resources is a priority assignment being carried out in South Africa and South-West Africa by the geological survey of the Union Department of Mines. The consulting geologist to the Union's Atomic Energy Board has commented on reports of a discovery of extensive deposits in the Letaba River area of the Northern Transvaal. A systematic survey has not

yet been started in that area, he stated. Of a total world production of 7,000 tons of beryllium last year the Union's output was 462 tons. The ore, 10 to 12% grade, sold at a little more than £100 ($280) a ton. The U.S. is a consumer of South African beryllium and the most recent shipment to that country totaled 19 tons and was valued at £2,000 ($5,600).

Kjellgren Joins Board

Bengt R. F. Kjellgren, president of Brush Beryllium Co., has been named a member of the board of directors of the newly-organized Beryllium Resources, Inc., Salt Lake City.

It also was announced by Beryllium Resources, Inc., president Bruce W. Odlum, Indio, Calif., that his firm and Brush were "cooperating under a working agreement that provides for a mutual exchange of information."

"We are pleased to be associated with a firm that has long been a leader in the beryllium field and to have as a director a man with the outstanding reputation in the industry as Mr. Kjellgren," Mr. Odlum said.

Mining Calendar

Fifth Symposium on Mining Research, Missouri School of Mines, Nov. 19-20

17th Annual Electric Furnace Conference, Cleveland, Ohio. Dec. 2-4

Northwest Mining Association, Spokane, Wash. Dec. 4-5

Annual meeting, AIME, New York, Feb. 14-18, 1960

Australasian Institute of Mining & Metallurgy, Adelaide Branch Symposium on Hydrometallurgy, "Wet Processing," of Minerals and Industrial Products," Feb. 16-19

Governor's Industrial Safety Conference, statewide meeting, San Francisco, Calif. Feb. 16-17

Symposium on Pilot Plants in Metallurgical Research and Development, Jamshedpur, India, February

National Western Mining Conference and Exhibition. Denver Hilton, March 17-19

Fifth International Mineral Processing Congress, Westminster, London. The Secretary, Institution of Mining & Metallurgy, 44 Portland Place, London, W.1, England. April 6-9

Southwest Metals & Minerals Conference, AIME, Los Angeles, Calif. April 21-23

International Congress on Research into Ground Control and Rock Mechanics, Paris, France. May 16-20

Wyoming Mining Association, Jackson Lake Lodge, Wyo. June 10-11

XXI International Geological Congress, University of Copenhagen, Denmark. American Geological Institue, 2101 Constitution Avenue, N.W., Washington 25, D.C. Aug. 15-25

(*This Month continues p 128*)

As We Went to Press . . .

A stringent mining code, proposed by Premier Fidel Castro in late October and passed by his government, will force holders of mineral claims to re-register them at $100 per claim by late February. A fee of $10 per hectare (2.47 acres) will be paid annually on claims being worked and $20 on those which are idle. The new law also demands development work within 60 days on all claims, or forfeiture.

The vast holdings of Bethlehem Steel Corp. in Oriente Province, which would have come under the law, were confiscated by the Castro government in early November, as were a number of large ranches.

Mineral producers in Cuba, under another tax law, must now pay a 5% tax on gross receipts for minerals and petroleum used on the island and 25% tax on concentrates which are exported. The latter ruling affects the operations of Moa Bay Mining Co., a subsidiary of Freeport Sulphur which is opening a $75-million nickel and cobalt facility in Oriente. Mobaco also holds some 3,000 hectares of ore-bearing land, and will ship its concentrate to Port Nickel, La. for further processing.

John C. Carrington, vice president of Freeport Sulphur, said that 25% tax was "very high," but noted that its full effect could not be estimated until the mining company determined what value the Castro government would place on the concentrates.

A Havana lawyer, Emilio A. San Pedro, called the tax on claims "prohibitive."

"An extensive deposit of high grade pollucite" averaging 24.4% cesium oxide has been developed at the African operations of Bikita Minerals, according to American Potash & Chemical Corp., which handles Bikita sales. Bikita's reserves are part of its large lithium-beryllium deposit near Fort Victoria, Southern Rhodesia.

Terms proposed by Industries Kaiser Argentina, S.A., with the Argentine steel firm of Acindar S.A. for development of the Sierra Grande iron ore mine in Rio Negro province include a three-stage, $50-million program. (See p 172.)

First stage involves open pit mining of 150,000 tons per year and construction of a plant. Stage two, which is contingent upon number one, supports delineation of the orebody for a proposed 2-million tpy output.

Stage three provides for open pit and underground mining at a daily rate of 7,700 tons. Acindar would build a steel plant on the Parana river in conjunction with the IKA project. The proposal is subject to local credits and guarantees, tax and surcharge-free import rights for equipment and tax exemptions.

Uravan Belt uranium-vanadium producers will have to mine more selectively and economically to participate in the 1962-1966 purchasing plans of AEC, according to Allan E. Jones of the Grand Junction operations office.

Jones said that ores will have to run on average from 0.20% to 0.30% or more U_3O_8 to be acceptable at mills under the price at which AEC will purchase the concentrates.

A large ilmenite deposit in Ocean County, N.J. has been purchased from American Metals Climax Co. by the Glidden Co. which will operate a mine to supply its pigment plant at Baltimore, Md.

WASHINGTON IMPACT

Highlights

FOR FUTURE REFERENCE—In terms of potential effect on the metal-mineral mining industries, one of the most significant policy decisions ever considered is under active current discussion in Washington. A study is underway to explore the feasibility of joining the U.S., Canada, and Mexico in a common market or free trade area comparable to the "inner 6" or "outer 7" that comprise Europe's two precedent-setting economically integrated trading areas. (See story, this page.)

As of now, the political as well as economic obstacles and objections far outnumber and outweigh the factors working in its favor. But by the same token, the significance of such a plan is underscored by the very fact that it is under any serious consideration at all.

Rationale for the plan runs along these lines:

If the U.S., Latin America, and indeed the whole western alliance is to meet the challenge of economic progress the current international situation presents, old ideas of world-wide multilateral trading negotiations must be modified. Europe already has set the pattern with its Common Market and new free trade zone, despite the many conflicts and complexities attending these experiments. Far from negating the European attempts, a North American common market, a South American grouping, and eventually a western hemispheric alliance in concert with Europe may be the answer that is needed to meet Soviet Premier Khrushchev's much-publicized declaration of economic war on the west. The thinking is as broad and long-range as that.

For the U.S. nonferrous mining industries, such a development would dramatically uproot traditional concepts. Already, imports of Canadian aluminum and petroleum, Mexican lead, zinc, fluorspar and sulphur—not to mention Venezuelan oil, Peruvian lead and zinc, or Chilean copper—have created strong domestic protectionist reactions.

Yet another reaction has been the international expansion of U.S. producers to those same areas. The ultimate impact of a North American, North-South American, or eventual Western Hemisphere trading alliance, therefore, would be on the few remaining strictly domestic mining companies.

The idea of closer hemispheric economic cooperation is not novel. But it is gaining favor in important Government circles. Meanwhile—and it is a long meanwhile for all practical purposes—other more immediate U.S. trade policy issues are fast becoming the major battlegrounds for domestic mining policy debate.

TRADE IS THE ISSUE—Trade, even more than Government subsidies or stockpile disposal, is the policy arena that domestic metal-mineral producers have selected as their prime target in Washington. This fact was clearly underlined at both the AMC annual convention in Denver and the conference of Western Governors last month.

Domestic lead-zinc miners' case before the Tarriff Commission for additional import protection will serve as the bellweather (see story this page).

Fluorspar has a similar appeal pending at Tariff Commission. It is the conservative Tariff Commission that now provides domestic petitioners for more import protection with the most attractive forum—backed, of course, by the potential lever of new import restrictions legislated by an election-minded Congress next year.

What the Commission has in mind, according to some observers, is a new application of tariff-quotas. In effect, this is the formula it used in granting domestic stainless steel flatware manufacturers additional relief last month. The Commission recommended—and the White House adopted—a scale of increasing ad valorem duties on imported stainless tableware ranging up to 67½%, which are to be applied whenever imports exceed a set quota limit on shipments at the present lower duties.

This is what at least some commissioners plan to recommend in the lead-zinc case, possibly for fluorspar as well. If such a pattern is set, it may well invite similar appeals from a number of other domestic metal-mineral producers.

Possibility Seen For An American Common Market

AN AMERICAN COMMON MARKET—Joining the U.S., Canada, Mexico, and perhaps eventually their South American neighbors in a free trade economic alliance—is attracting top-level official interest in Washington.

Domestic business opposition, particularly in the extractive industries, would of course weigh heavily against such a plan, unless specific exemptions and safeguards were provided for raw commodities—oil, lead, zinc, aluminum, and others.

If the American market were patterned after Europe's common market or the even newer free trade area, such provisions could be allowed. But even then, inherent competition in many areas between the prospective members would cause drafters of a common market plan a lot of headaches.

Any regional American market scheme also would allow for tariff reductions and quota lifting to come in gradual steps. Its formation, even after an official approval by the prospective member nations, would take years.

Officials in Washington are practically certain that Central and South American markets will be formed and will work before long. And it is in this context some U.S. officials are thinking it may not be a bad idea to have a North American market underway by that time. Their reasoning is that more regional groupings not only won't work against the start already made in Europe, but will pave the way toward possible eventual economic challenge of the Communist bloc.

Two significant examples of how the North American continental pact idea is gaining favor are (1) The exemptions for Canadian oil from the existing mandatory oil import quotas, and (2) The turndown fluorspar producers received at OCDM on their petition for additional protection against Mexican imports on grounds of the domestic industry's defense essentiality. Both decisions were based on the theory of "contiguous land areas"—which means even in time of national emergency the U.S. expects to enjoy uninterrupted access to Canadian and Mexican sources of supply.

Tariff Relief Schedule May Aid Lead and Zinc

LEAD-ZINC'S FIGHT for import protection—which of course would be seriously affected by any American common market plans—meanwhile is building up slowly toward a climax.

The unofficial word from Tariff Commission is that those members who favor tighter restrictions on both ores or concentrates and products are planning to urge a tariff-quota solution similar to the

Commissions' recent action on Japanese stainless steel flatware.

This formula would place a restrictive ad valorem duty (67½% in the flatware case) on all imports above a set quota limit.

Meanwhile, smelters and U.S. companies with international interests are reported to be seeking another United Nations lead-zinc meeting. The industry word is that the voluntary production quotas agreed to at the last UN session are not being adhered to, and those who favor freer international trade want to see production checked before another world glut and price collapse again paves the way for more trade restriction.

Chances that such a meeting will be called are slim, if only because of the somewhat improved international market picture since the last emergency meeting.

Certainly no U.S. policy change in existing quotas is in the cards until after the bellwether case before the Tariff Commission. Even though a similar investigation of fluorspar will get started before the lead-zinc case, Tariff Commission plans to delay its fluorspar findings until after the March 31, 1960 deadline for its lead-zinc decision.

Some Senators, Fearing Shortage, Eye Stockpile

STOCKPILE DISPOSAL—this time relating to copper and cadmium—is in the news again. Although the Administration has delayed until at least next year its broad new plan for greater disposal authority, OCDM, through GSA, is using what authority it does have to rid itself of excess or obsolete stocks of materials where no industry or Congressional controversy appears.

But the agency ran into unexpected opposition over its announced release of magnesium scrap. The decision brought strong protests from domestic cadmium producers, who argued that the magnesium scrap was in fact composed of as much as 90% cadmium. Mining-state Senators have asked OCDM to hold up on its magnesium scrap release.

The same mining-state bloc on Capitol Hill also is again talking to OCDM about prospective release of copper stocks. In this case, the situation is virtually reversed. Worried over London market rises in copper prices, the threat of a prolonged copper labor strike and a serious international shortage, Congressional sources are telling OCDM they now would approve the release of as much as 10,000 tons of stockpiled copper, four times what they said they would approve a few months ago. However, the legislators are insisting on similar safeguards as contained in their earlier informal proposal—namely, that no copper be released during the strike unless a crippling international market shortage seems apparent. Pressing for release are copper fabricators, who argue they face an increasing shortage.

Labor This Month

HALTING THE BIG STRIKES—THE JOB AHEAD:—When Congress convenes in January, it will smack into another labor problem. The legislators, who thought they were rid of the subject by passing a labor reform bill last summer, once again must face up to changing the Taft-Hartley Law. On the carpet this time are the law's strike-stopping injunction processes. While President Eisenhower invoked the strike ban in the steel dispute, he wasn't enthusiastic about it helping a settlement. The big question facing Congress—what system will do the job?

TAFT-HARTLEY, A MIXED BLESSING: In past practice, use of the T-H 80-day injunction has a poor record. In only five of 17 such injunctions were disputes settled during the strike embargo. One such case involved the nonferrous metals dispute of 1951. When the Korean War was in progress. The injunction was invoked one week after the strike started. Barely one month later, the mine companies and the Mine-Mill and Smelter Workers had wrapped up settlements. But, there was wartime pressure on the parties.

Even unions are mixed on feeling about T-H. In the steel dispute, the United Steelworkers fought hard against the law. President Eisenhower left out copper when he moved against the steel strike. But there's evidence that Mine-Mill members, who felt they might be waiting a steel settlement to wrap up their own agreements, would have welcomed a return to work.

THE SOLUTION, A CLUB OR A NUDGE: The one sure effect of the strike flare-up is this—the Government from now on will take a bigger seat at the bargaining table. In Big Steel, the negotiators went for more than four months without any real bargaining. Now, the Government is determined to see this doesn't happen again. It will keep a much closer tab on the parties.

While the end is already resolved, there are many means being proposed. They vary from forced settlements to subtle pressure on labor and management. The most seriously considered solutions are these: Compulsory arbitration, where the contract terms are laid out by the Government; voluntary arbitration, where both sides are pressured to agree to outside solution; fact-finding boards where bargaining stalls, to conduct open mediation sessions before the public; and, among others, a proposal to put unions under the anti-trust laws and break up industry-wide strikes.

BACK TO THE "HOUSE OF LABOR": Within the AFL-CIO, the pressure is mounting to bring the Mine-Mill and smelter workers union back into the big labor federation. It's being promoted within the federation's metal trades council. The latest move came at the council's recent convention and though it made no official headway, the issue is still alive. Here's the formal proposal of metal trades department president J. A. Brownlow: The AFL-CIO should "either affiliate the recognized metal mining union (Mine-Mill) or grant a metal mining charter" among the AFL-CIO mining local unions.

AFL-CIO president George Meany has the final say on this. The AFL-CIO's metal branch argues that the nonferrous mine unions are more closely aligned than the unions within the federation. Specifically, it criticizes the United Steelworkers for raiding nonferrous jurisdiction—making the steel union the common rival of the nonferrous unions inside and outside the AFL-CIO.

WAGE GAINS TAPER OFF: While attention centered on the steel and copper strikes, other 1959 bargaining showed some surprising trends. The late summer settlements fell off in costs from the 9 cent figure of the first six months. The new average is about 8 cents. Too, the big disputes delayed other settlements. Employers were all watching to see what the steel and copper price tags were going to amount to—before committing themselves to new contracts.

MARKETS

Copper Prices Jumping Everywhere; Zinc Prices Up; Aluminum Output Cut

NON-FERROUS METAL-PRICES moved up to 126% of the 1947-'49 average in October from 122.5% in September, according to the E&MJ index of non-ferrous metal prices. The rise reflected mainly the higher price of copper though the increase in zinc also contributed.

Copper prices jumped in October as strikes caused shortages in the U.S. and elsewhere. London October 1 was £228½ prompt bid. October 30 it was £258; on the 28th it was £265(33c a lb).

In the U.S. the month opened with copper at a number of prices. Kennecott was at 30c delivered. Other U.S. producers were at 31½c and some custom smelter copper was priced at 33c. Some imported producer copper was being sold in the U.S. at 34.7c including the 1.7c import duty. Merchant copper was being offered in the U.S. at about 35c to 35¼c a lb delivered. The offering price moved up to about 35¾c the following day. By the end of the month this price had hit 39c or 39¼c.

In Europe copper was held in firm hands. At the beginning of October Copper Institute statistics showed 275,100 short tons of copper held in stocks outside the U.S. At the beginning of the year only 203,765 tons were in stocks and this increased to 286,736 at the end of July. It dropped only about 11,500 tons from the end of July to the end of September. October stocks outside the U.S. are likely to be much lower owing to the Braden strike in Chile and to shipments to U.S. consumers.

London three months copper was £13 to £17¼ under prompt copper. This in part reflected the view that the shortage would ease. It also suggested that speculative interests were buying copper contracts.

At the end of October Kennecott was still pricing some copper at 30c delivered in the U.S. Some producers were at 31½c. No custom smelter copper price was being quoted. The price for each sale was negotiated. Custom smelter supply was uncertain and their sources were varied.

Mine production of copper in the U.S. dropped in September to 19,166 short tons. With the strike at White Pine the last week of October it is improbable October data will show an improvement. Stock in the U.S. dropped in September to 61,525 tons according to Copper Institute data. Shipments to fabricators were 92,501 tons, up 2,400 from August. Much of this was imported copper.

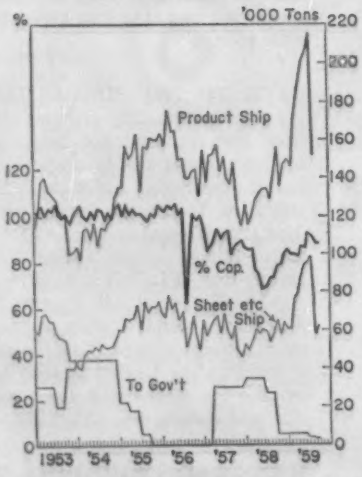
None of the U.S. copper strikes were settled in October. Mine-Mill in Montana turned down the Anaconda offer. Kennecott was still negotiating. The strike of Kennecott's properties in Chile was settled November 1. The Belgian Congo transport workers strike was settled but rioting again developed; so far it has not affected copper areas.

The outlook was for higher copper prices in the U.S. Largely owing to demand based on U.S. consumers' needs, 265 lb wire bar premiums in Europe had been as high as £21 late in October. Settlement of the Braden strike may ease the LME but if U.S. strikes are not ended the copper shortage will get worse.

Aluminum sheet prices were slashed by Alcoa October 2. There had been two classes of aluminum sheet, utility and specification. The latter was priced much higher than the former. Alcoa has introduced a new sheet that is priced about 15% under the utility sheet and about 25% under specification sheet. But not only is it of better quality than utility sheet, it is equal to much specification sheet. Some independents say it is revolutionizing the sheet industry which takes about 40% of all aluminum. The product is directed at the building industry but can be used for other purposes.

The major aluminum producers sell aluminum products including sheet in competition with their pig and ingot customers. The latter have complained for years about being squeezed between the price they are charged for metal and the price at which they have to sell their products. The new prices greatly worsen this situation. Some independents said they would need a sizeable cut in pig prices in order to remain in business. They also indicate the income of the big producers is likely to be hit hard by the new prices. The latter say in the long run production economies and increased sales are likely to more than offset the lower prices.

U.S. Aluminum



The heavy line and the left hand scale show the % of primary capacity at which the industry is operating. Product shipments (Census Bureau data) are the total tonnage of aluminum fabricated products and castings shipped—these products are made from primary, secondary and imported metal. "Sheet etc. shipments" are Aluminum Association data for sheet and foil for regularly reporting companies. All data through September except product shipments through August.

The price outlook for aluminum is uncertain. Most analysts feel higher wage costs are certain. Aluminum company profits have been so low that it is felt prices must be raised to offset these costs. But imports of aluminum products have been increasing this year—higher prices would invite further inroads. And Aluminium Ltd., large Canadian exporter, has implied that it would not raise its pig price. It sells about 200,000 tons in the U.S. It had dropped the price 2c two years ago.

Kaiser cut output from 90% to 80% of capacity. Reynolds has announced it cut to 91% from 100% in September and is now dropping to 80%.

Prime Western zinc was raised to 13c a lb East St. Louis by American Metal Climax October 21. Some producers followed but many sellers stayed at 12c. No sales were made on the 21st at 13c. Sales were made at 12c on the 21st, 22nd and 23rd. On the 23rd a custom smelter raised to 12½c and at least one producer that had gone to 13c dropped to 12½c. A few sales have been made at 13c. Nov. 2 the 13c sellers dropped to 12½c.

When the 13c price was announced October 21 exceptionally heavy sales were made at the old price of 12c. It repeated the September 21 situation in which buyers were backed in at the 11c price. Some sellers say many zinc consumers are bought up through December and some well into January.

Some companies said the price rise in Europe for zinc made a rise in the U.S. necessary. The London Metal Exchange on October 20 was 11¾c. On the 21st it was 12c for prompt bid. With import duty of .7c and ocean freight of about .8c this is 13½c at U.S. ports. Some U.S. ore buyers said they could not buy foreign concentrates at the 12c price basis.

The higher European prices reflect the improved demand there. Business conditions had been improving. Use of die-casting zinc had been increasing. Some factors say this had caused some producers to divert zinc from the galvanizing grade and that this created a shortage in the lower grades. The increased demand for European steel products, including galvanized, stemming from the U.S. steel strike contributed to the higher LME prices.

Lead sales in October were exceptionally low. Lead sellers indicate they have plenty of lead outside struck plants—it was poor demand that had cut sales. This largely followed from the heavy stocking by buyers. In August they had stocked up; they had bought heavily in April and May.

Average Prices October *(E&MJ Quotations)*

Cents per lb unless otherwise indicated:

Copper:	
Electro, domestic refinery	32.576
Electrolytic, export refinery	29.150
Electrolytic, c.i.f. Cont'l ports	30.095
Lead:	
Common, New York	13.000
Common, St. Louis	12.800
Silver:	
Silver, New York, per oz	91.375
Silver, London, pence per ox	79.955
Zinc:	
Prime, Western, East St. Louis	12.129
Prime, Western, delivered (g)	12.629
Tin:	
New York Straits	102.274
Gold, per oz, U.S. price	$35.000
Sterling Exchange	280.627
Quicksilver, per flask	$223.333
Antimony (E&MJ) (d)	32.590
Antimony, bulk, Laredo	29.000
Antimony, in cases, Laredo	29.500
Antimony, for 99½%	24.500
Platinum, refined, per oz	$77.000
Cadmium (a)	130.000
Cadmium (b)	140.000
Al, 99½% dom., ingot	26.800
export, pig	22.500
Magnesium, ingot	35.250
Nickel (f)	74.000
Bismuth	$2.250
Cobalt	$1.750

Domestic quotations, unless otherwise stated, are in cents per lb. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.

Custom Smelter Copper

Based on flat price and E&MJ average prices sales in U.S. for month of October reported by American Smelting & Refining Co.; electrolytic copper in standard shapes, adjusted to nearest ⅛c; ¼c deducted for selling common.

Delivered consumers' plant	32.625 lb
F. o. m. refinery	32.225 lb.

Free Gold Market

International gold dealings declined 14% during October. Bar prices eased fractionally while coins were lower by about 2%. London and Paris markets were quiet, each listing daily transactions of about $1 million. Indian trade volume rose on currency weakness. No Soviet gold sales were reported. Global private gold hoards increased 3⅛% above their 1958 total according to latest figures. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	Coins		Bars (12.5 kg)	
	Sept. 30	Oct. 30	Sept. 30	Oct. 30
New York transit			$35.08½	$35.08½
Manila	$41.75	$41.00	36.10	35.85
Hong Kong	46.00	46.10	38.85	38.60
Bombay	58.75	57.50	57.0[illegible]	55.75
Tangier	40.25	39.50	35.3[illegible]	35.25
Beirut	40.70	40.50	35.18½	35.18½
Paris	40.55	40.00	35.60	35.70
Buenos Aires	39.55	38.75	36.40	35.80

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

Oct. 1959	Electrolytic Copper (a) Domestic	Electrolytic Copper (b) Export	Europe c.i.f. (c)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99% U. S. Dest.	Straits Tin New York
1	32.325	27.700	28.645	13.000	12.800	12.500	12.000	24.700	102.875
2	32.500	27.825	28.770	13.000	12.800	12.500	12.000	24.700	103.250
5	32.450	28.050	28.995	13.000	12.800	12.500	12.000	24.700	103.375
6	32.650	28.075	29.020	13.000	12.800	12.500	12.000	24.700	103.250
7	32.550	28.125	29.070	13.000	12.800	12.500	12.000	24.700	103.125
8	32.175	27.975	28.920	13.000	12.800	12.500	12.000	24.700	103.125
9	32.375	28.075	29.020	13.000	12.800	12.500	12.000	24.700	102.750
12	Holiday	28.000	28.945	Holiday					
13	31.825	28.000	28.945	13.000	12.800	12.500	12.000	24.700	102.500
14	32.425	28.125	29.070	13.000	12.800	12.500	12.000	24.700	102.375
15	32.500	28.025	28.970	13.000	12.800	12.500	12.000	24.700	102.250
16	32.500	28.550	29.495	13.000	12.800	12.500	12.000	24.700	102.250
19	32.575	28.650	29.595	13.000	12.800	12.500	12.000	24.700	101.750
20	32.600	28.650	29.595	13.000	12.800	12.500	12.000	24.700	101.750
21	32.175	29.450	30.395	13.000	12.800	12.500	12.000	24.700	101.625
22	33.075	29.150	30.095	13.000	12.800	12.502	12.002	24.700	101.625
23	32.675	30.950	31.895	13.000	12.800	12.539	12.039	24.700	101.625
26	33.300	30.925	31.870	13.000	12.800	13.000	12.500	24.700	101.750
27	32.675	31.525	32.470	13.000	12.800	13.000	12.500	24.700	101.625
28	32.875	32.375	33.320	13.000	12.800	13.000	12.500	24.700	101.625
29	33.000	31.300	32.245	13.000	12.800	13.112	12.612	24.700	101.625
30	32.875	31.800	32.745	13.000	12.800	13.063	12.563	24.700	101.625
AVERAGES FOR MONTH									
Oct.	32.576	29.150	30.095	13.000	12.800	12.629	12.129	24.700	102.274
AVERAGES FOR WEEK									
Oct.									
7	32.495	27.955	28.900	13.000	12.800	12.500	12.000	24.700	103.175
14	32.200	28.035	28.980	13.000	12.800	12.500	12.000	24.700	102.688
21	32.470	28.665	29.610	13.000	12.800	12.500	12.000	24.700	101.925
28	32.920	30.985	31.930	13.000	12.800	12.808	12.308	24.700	101.650
CALENDAR WEEK AVERAGES									
Oct.									
2	31.655	27.705	28.650	13.000	12.800	12.500	12.000	24.700	102.775
9	32.440	28.060	29.005	13.000	12.800	12.500	12.000	24.700	103.125
16	32.313	28.140	29.085	13.000	12.800	12.500	12.000	24.700	102.344
23	32.620	29.370	30.315	13.000	12.800	12.508	12.008	24.700	101.675
30	32.945	31.585	32.530	13.000	12.800	13.035	12.535	24.700	101.650

THE above quotations for major nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.400c per lb., the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance, Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per lb. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective Sept. 2, 1959, commanded a premium of 1.25c per lb over the current market for Prime Western; Special High Grade 1.50 effective Sept. 2, 1959.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U.S. lead is corroding grade).

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver 999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy oz 1000 fine effective July 1, 1946. London silver in pence per troy oz, basis 999 fine.

(d) U.S. Treasury's gold price is $35. Actual payment by the U.S. Treasury for gold is at 99.75% of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Oct. 1959	Silver (a) New York	Silver London	Sterling Exchange	Gold (d) London
1	91.375	79.125d.	280.5025	250s. 6¼d.
2	91.375	79.125d.	280.4860	250s. 5d.
5	91.375	79.125d.	280.4000	250s. 5d.
6	91.375	79.375d.	280.2600	250s. 6¾d.
7	91.375	79.500d.	280.4120	250s. 7¼d.
8	91.375	79.500d.	280.4920	250s. 4¼d.
9	91.375	79.750d.	280.9140	250s. ¼d.
12	Holiday	80.000d.	Holiday	249s. 11¾d.
13	91.375	80.250d.	280.8640	249s. 11¾d.
14	91.375	80.250d.	280.7525	250s. ¾d.
15	91.375	80.250d.	280.7040	250s. 1¾d.
16	91.375	80.250d.	280.7780	250s. ¾d.
19	91.375	80.250d.	280.8280	249s. 11d.
20	91.375	80.250d.	280.8080	249s. 10¾d.
21	91.375	80.250d.	280.7560	249s. 11¾d.
22	91.375	80.250d.	280.7550	249s. 11¾d.
23	91.375	80.250d.	280.6750	250s. 0d.
26	91.375	80.250d.	280.6500	250s. 0d.
27	91.375	80.250d.	280.5275	250s. ¾d.
28	91.375	80.250d.	280.4920	250s. 1¾d.
29	91.375	80.250d.	280.5800	250s. 1¾d.
30	91.375	80.250d.	280.5200	250s. ¾d.
AVERAGES FOR MONTH				
Oct.	91.375	79.955d.	280.627	—
AVERAGES FOR WEEK				
Oct.				
7	91.375	—	280.412	—
14	91.375	—	280.756	—
21	91.375	—	280.775	—
28	91.375	—	280.620	—

Calendar Week Averages: New York Silver: Oct. 2, 91.375; Oct. 9, 91.375; Oct. 16, 91.375; Oct. 23, 91.375; Oct. 30 ,91.373.

MARKETS (*Continued*)

London Metal Exchange Quotations

Oct.	Copper Cash Bid	Copper Cash Asked	Copper 3 Mon. Bid	Copper 3 Mon. Asked	Lead Current Month Bid	Lead Current Month Asked	Lead 3 Mon. Bid	Lead 3 Mon. Asked	Zinc Current Month Bid	Zinc Current Month Asked	Zinc 3 Mon. Bid	Zinc 3 Mon. Asked	Tin Cash Bid	Tin Cash Asked	Tin 3 Mon. Bid	Tin 3 Mon. Asked
1	228½	228¾	229½	229¾	70	70¼	71¼	71⅜	86¼	86⅜	85	85¼	793½	794	794	794½
2	234⅝	235	234	234½	70¼	70⅜	71⅜	71½	86⅝	87	85⅛	85⅜	794	794½	794½	795
5	235½	235⅝	235	235½	70⅛	70½	71⅜	71⅝	87	87¼	85¼	85⅜	794	794½	794½	795
6	233¾	234	233½	233⅝	70	70⅛	71	71⅛	86½	87	85	85¼	793½	794	793	793½
7	233⅝	234	233¼	233½	70	70⅛	71¼	71¼	87	87¼	85¼	85½	794	794½	794½	795
8	232¼	232½	232¼	232½	70⅛	70⅝	71⅛	71⅝	87⅛	87¼	85⅜	85½	794	794½	794½	795
9	232	232¼	232⅛	232½	70⅛	70⅝	71⅜	71⅝	87	87⅛	85⅜	85½	794	794½	794½	795
12	230¼	230½	230½	230⅝	70⅛	70⅝	71⅜	71⅝	87⅛	87⅜	85¼	85½	794	794½	794½	795
13	230⅝	231	230⅝	231	70⅛	70⅝	71⅝	71⅞	88⅛	88⅝	86	86¼	794	794½	794	794½
14	232¼	232⅝	232½	232½	70	70⅛	71¼	71⅝	88⅝	89	86½	86⅝	794	794½	794	794½
15	234⅛	234⅜	234	234¼	69⅛	69⅝	71¼	71⅝	90¼	91	88	88¼	793½	794	793	793½
16	234	234½	233¼	233⅝	70⅛	70⅝	71⅝	71⅞	90½	90⅝	87⅞	88	793½	794	792½	793
19	235	235⅛	234½	234⅝	70⅝	70⅞	71⅞	71⅞	91½	92	89	89½	794	794½	793½	794
20	240	240¼	237¼	237½	71	71⅛	72⅛	72⅜	94	94¼	90¾	91	794	794½	794	794½
21	243½	244	239	239½	71⅝	71¾	72⅝	72⅞	96¾	97	93	93¼	794	794½	794	794½
22	249	250	240¾	241	71⅛	71⅜	72¼	72⅜	96½	97	92¾	93	794	794½	794	794½
23	260	261	245	245½	71⅜	71⅝	71⅝	72	93	93½	89¾	90	794	794½	794¼	795
26	256	256½	241½	242	71	71⅛	71⅝	72	94⅜	95	90¾	91	794	794½	794	794½
27	264½	265	245½	246	71⅛	71¾	72	72⅛	96¼	96½	91¾	92	794	794½	794¼	795½
28	265	265¼	247½	248	70⅝	71	71⅝	71⅞	97	97½	92	92¼	794	794½	795	795½
29	254	255	241	242	70	70⅛	71	71¼	96	96½	91¼	91½	793½	794½	795	796
30	258	259	244½	245	71	71¼	71⅝	72	97¼	98	92½	92½	793½	794	795¼	796
Av'g's	£241.920		£236.875		£70.619		£71.608		£91.366		£88.457		£794.136		£794.432	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.9%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty paid.

MISCELLANEOUS METALS

Oct. 30, 1959

Aluminum ingot, 99 plus % lb	26.8c
Antimony, spot, lb, less than carload, in cases	32.59c
In bulk, carload lots, f.o.b. Laredo	29.00c
Imported, 10 ton min. (p), 99½%	24½c
Bismuth, ton lots, lb	$2.25
Cadmium, ton lots delivered, lb	$1.30
small lots	$1.40
Calcium, lb, ton lots, 98%, cast	$2.05
Chromium, 97% grade, lb, contract delivered	$1.29
Cobalt, 97 to 99%, per lb effective Feb. 1, 1957	$1.75
Germanium, per gram, 10,000 gram lots	(d) 33c —(c)(d)35c
Indium, troy oz	$1.25 — $2.25
Lithium, lb, 98%	$9.00 — $11.00
Nickel, cathodes, lb (a)	74c
Other sales, regular sellers	74c
Sales by dealers, etc.	74c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16	35½c
Palladium, troy oz	$20.00 — $22.00
Platinum, troy oz	$77 — $80
Quicksilver, flask of 76 lb, 25 flasks or more	$222 — $225
Selenium, 99 plus %, lb—(Feb. 19, 1958)	$7.00
Silicon, minimum 98%, carloads, lb	19c
Semi Conductor grade, lb	$360
Tellurium, lb	$2.50
Thallium, 100 lb or more	$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 — $1.60

(a) Effective Dec. 6, 1956; including U.S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu: spot	$31.75–32.50
term contracts	$34–34.50
Chrome ore per long ton, f.o.b cars Atlantic ports, dry:	
44% Cr_2O_3 no ratio	$17.50—$18.00
48% Cr_2O_3 3 to 1 ratio	$34 — $37
Iron ore, Lake Superior, Lower Lake ports, lt	
Old Range bessemer	$11.85(c)
Mesabi bessemer	$11.60(c)
Mesabi non bessemer	$11.45(c)
Lead (Galena), 80%, Joplin, Mo., ton	$156.12
Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.	
Molybdenum ore, 90%, per lb of Mo f.o.b. mines	$1.25
Columbian-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.10 — $1.20
Tungsten ore, per stu of WO_3:	
Foreign 60%, c.i.f. U.S. ports, duty extra	$16
U. S. scheelite, f.o.b. mill	$22 — $24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines	31c
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton.	$80

(a) Nominal. (b) c.i.f. U.S. ports.
(c) Effective 1958 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks	4–5c
Cobalt oxide, 72½% to 73½%, per lb, effective Dec. 1, 1956	$1.33 — $1.36
Copper sulphate, 100 lb, effective July 14, '59	$11.95
Germanium dioxide, gm	18½c
Molybdic trioxide, technical, per lb of Mo	$1.46 — $1.47
Imported, including 37c duty	$1.75 — $2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)	28¼c
Ferromanganese, 74 to 76%, per lb shipping point	12¼c
Ferromolybdenum, 58 to 64% Mo. Lb of Mo contained.	$1.50 — $1.82
Ferrosilicon, 50% per lb of Si f.o.b. shipping point (3-1957)	14.60c
Ferrotungsten, 72 to 82%, lb of W contained	$2.15
Ferrovanadium, per lb of V delivered	$3.20 — $3.40
Silicomanganese, max. 1½% c, lb contracts	12.8c
Spiegeleisen, per lt, 10—21% grade effective Jan. 7	$102.50

NONMETALLIC MINERALS

Asbestos, f.o.b Canada (Quebec) mines (Canadian funds) ton:	
Crude No. 1	$1,400 — $1,810
Crude No. 2	$750 — $1,155
Spinning fibers	$370 — $600
Shingle fibers	$180 — $220
Paper stock	$120 — $145
Waste	$75 — $86
Shorts	$40 — $75
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):	
Crude No. 1	$1,522
Spinning fibers	$220 — $787
Asbestos, Vermont, f.o.b. Morrisville:	
Spinning fibers	$370 — $428
Shingle stock	$181 — $200
Paper stock	$120 — $152
Waste, stucco or plaster	$86
Refuse or shorts	$41 — $75
Barytes f.o.b. cars:	
Georgia, crude, per ton	$18
Missouri, 94%, $BaSO_4$, per st	$16 — $18
Crude oil well grade, min. 4.3 sp gr, st (a)	$18
Imported, c.i.f. Gulf Ports, st	$16 — $18
Bauxite, st, f.o.b. point of shipment:	
Domestic, crude, 50%, 8% Fe, 13% Si	$12.25 — $13.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, depending on grade	$7.14
Feldspar, bulk ton:	
Potash or soda feldspar, 200 mesh, ceramic grade	$20.50 — $21
Glass feldspar, white, 20 mesh	$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 — $41
60% effective CaF_2	$33 — $36.50
Acid 97% concentrate, bulk, ton (effective 12-1-56)	$50.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 — $14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington	$46

Mica—Domestic, f.o.b. mines. Punch 7c—12c per lb according to size and quality. Sheet clear 1½x2 in. 70c—$1.10; 2x2 in. $1.10 to $1.60; 2x3 in. $1.60—$2.10; 3x3 in, $1.80—$2.30; 3x4 in. $2.00—$2.60; 3x5 in, $2.60—$3.00; 4x6 in, $2.75—$4.00; 6x8 in, $4.00—$8.00. Wet ground, very fine, $140—$155 per ton, Bulk sales, dry ground; $30—$55 per ton. Scrap $20—$30.

Ocher Georgia, ton in sacks	$26.50 — $32.00
Pyrites, Spanish, per lt unit of S c.i.f. Atlantic ports	Not quoted
Sulphur, per lt f.o.b. vessel: bright	$21.50
dark	$20.50
Mexican, for use in Mexico, per metric ton, f.o.b. mines, 280 to 395 pesos, depending on location	$22.40 — $31.60
For export f.o.b. vessel, lt, depending on grade	$21.50 — $22.50
Talc, f.o.b. works, ton:	
New York, purified	$18.00 — $20.00
Vermont, extra fine	$12.50
Tripoli, Missouri, ton:	
40-mesh, cream colored	$50.00

(a) Some restricted sales at $11.50. (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces	$66.00
Steel, f.o.b. Pittsburgh, billets, net ton	$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 — $5.50

DENVER Engineered AGITATION

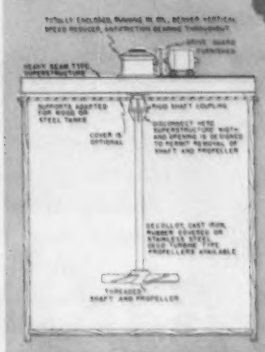
We have the tools to help you solve your TOUGHEST Agitation Problems... *Profitably!*

✻ DENVER Agitators for Mixing and Leaching

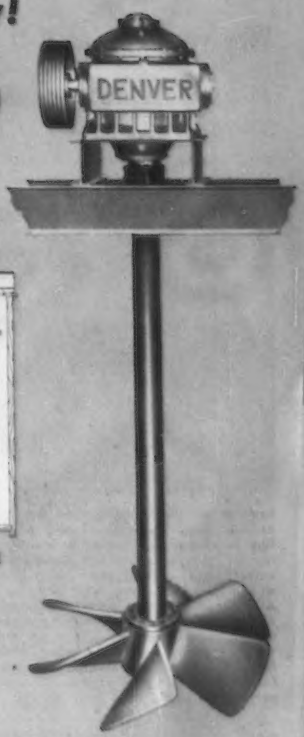
New Turbine Type Propeller Agitators have been developed up to 120" in diameter propeller size for use in large diameter tanks. This permits operation at slower speeds and at lower horsepower, yet effective agitation is obtained with pulps and slurries as coarse as 8 mesh. Special propeller blade design features eliminate cavitation, minimize wear, assure long life.

Equipped with DENVER Reducer Drive, a compact, totally-enclosed, self-lubricated speed reduction drive. Many speed selections, simple construction, easy, trouble-free maintenance.

Extensively proved in uranium mills—and for pulp suspension applications in leaching, mine backfill holding tanks and chemical processing.

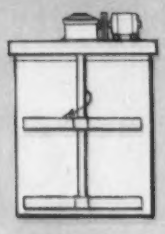


TURBINE TYPE AGITATOR



SIZES TO 120" AND LARGER DIAMETER

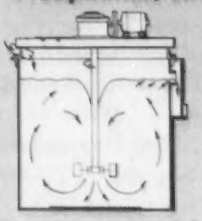
✻ DENVER Agitators for Suspension



PADDLE AGITATOR

DENVER Paddle Agitators are designed for applications involving the gentle mixing of solutions or slurries containing solids of fine particle size. Equipped with DENVER vertical shaft speed reducer.

✻ DENVER Agitators for Mixing, Precipitation, Stripping



VERTICAL TURBINE AGITATOR

DENVER supplies agitators of the vertical turbine type for intimate mixing, precipitation and stripping. A complete line of worm gear drive units are available to power these impellers at correct horsepower and speed for your applications. Mixing propellers available in full range of sizes to provide desired mixing intensity.

✻ **DENVER can supply Agitators Mixers in a full range of types sizes . . . for conditioning, mi scrubbing, leaching, precipitc aeration, etc., for either bat continuous operation. Write fo letin No. A2-B4.**

"The firm that makes its friends happier, healthier and wealthier"

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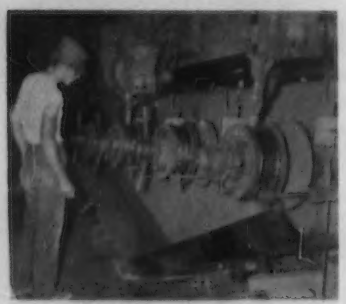
Increase the life of your wheels with S-D Hard-Faced Treads and Flanges...

"Modern mass-production equipment has catapulted Sanford-Day into the position of top mine wheel 'rehabilitation center' of the country."

—Fusion Facts

Why you save on S-D Hard-Faced Wheels (New or Reclaimed)

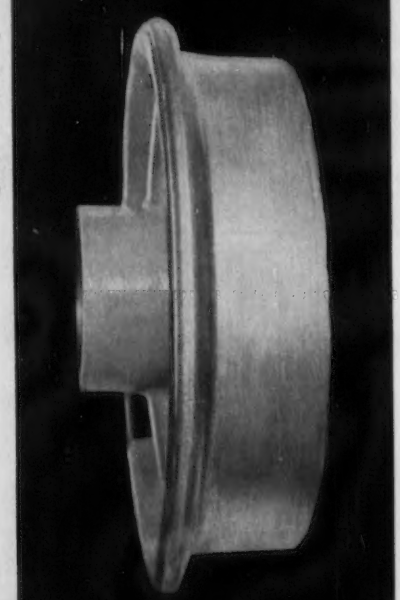
For years wheels like the one at right had to be discarded. Its (1) Tread and (2) Flange are "worn-out". But otherwise the wheel is as sound and serviceable as a new one. We have solved the problem of getting **wearing material** on a wheel where it does some good . . . **on the tread and flange where it is used!** We have reclaimed thousands upon thousands of "worn" wheels by successfully applying high alloy materials to the tread and flange of discarded wheels. These reclaimed wheels have earned such favorable savings, and due to oftentimes tripling their service life, many users have been ordering **new wheels** S-D Hard-Faced. They save the cost and down time of changing and reclaiming wheels when ordinary wheel flange and tread wear out.



Several completely automatic fixtures, such as this one, were developed at Sanford-Day in cooperation with the welding industry to mass-produce S-D Hard-Faced new wheels and reclaim old ones. Heads are shown here depositing high alloy on treads. A different alloy is used on flanges. Secret of long wheel life is obtaining wheels furnished with wearing surface on treads to take "impact", while wearing surface on flanges will take "scrubbing". S-D Hard-Facing assures you maximum and equal service of both tread and flange!

What counts is the proper alloy on the tread and flange! Over given period of time your wheel requirements will be reduced substantially when you order and use S-D Hard-Faced Wheels. Write us today for BULLETIN E-100 that furnishes complete information and specifications. **Sanford-Day Iron Works, Inc., P. O. Box 1511 . . . Telephone 3-4191, Knoxville, Tennessee.**

Worn wheel above shows typical condition of wheels formerly discarded. Field reports and customer experiences with S-D Hard-Faced Wheels show that reclaimed wheels, like one below, often give three times the service life of unprotected ones at far less than new part cost.

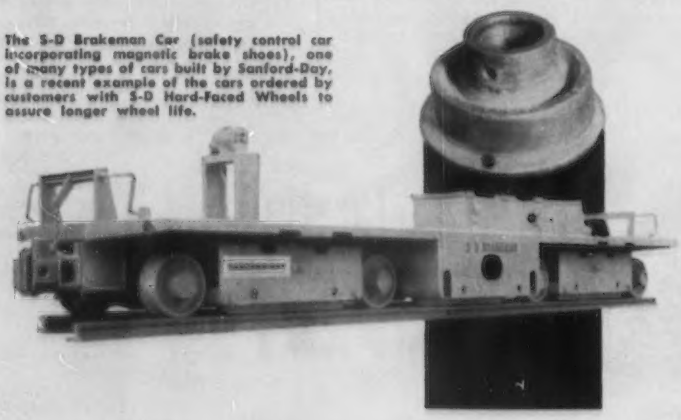


SANFORD-DAY

KNOXVILLE, TENNESSEE

Pictured below is a test wheel after many months service in severe service. It shows no appreciable wear on the S-D Hard-Faced tread and flange.

The S-D Brakeman Car (safety control car incorporating magnetic brake shoes), one of many types of cars built by Sanford-Day, is a recent example of the cars ordered by customers with S-D Hard-Faced Wheels to assure longer wheel life.



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AUTOMATIC SAMPLERS
DRYERS
Marquinarias 270
Casilla 4950
Phone 47887

Walker Cut Stone Co., Milford, Kansas, replaced six smaller overworked gasoline haulers with only two 19-ton Model 65 Payhauler trucks! Their "65's" deliver 150 tons of limestone per hour, from quarry to crusher.

How new rock-ribbed 65 Payhauler® pair speeds "write-off," replacing six smaller rigs!

—for Walker Cut Stone Co., Milford, Kansas

Two new International 19-ton 65 Payhauler trucks —with the new weight-saving corrugated bodies, and the new 250-hp D-817 diesel engine—have replaced six smaller gasoline trucks for Walker Cut Stone Co., Milford, Kansas.

Results are amazing! Only two operators instead of six to pay! Only 40 gallons of low-cost diesel fuel used daily (total) by the two Payhauler rigs—against several times 40 gallons of high-priced gasoline formerly swilled by the carbureted outfits! And only two machines to maintain, instead of six! "Write-off" of the Payhauler investment speeds in "high gear!"

Payhauler features increase capacity!

Even against competitive haulers of similar rated capacity, the new 65 Payhauler gives you overwhelming advantages!

Of all off-road haulers in its size class, only the 65 Payhauler has the International-developed rock-ribbed corrugated body! This strength-multiplying principle lets the "65" shed 5,000 lbs. of power-wasting weight, and gain a full ton of payload capacity.

Prove the power-to-payload advantages the new rock-ribbed 65 Payhauler delivers! Compare the "65's" cycle-speeding combination of air-assist shifting; 11-second dumping, fast reversing; super-power braking; bonus-leverage, vibration-free power steering! And for 27-ton capacity, note how the 375-hp "95" leads the field. See your International Construction Equipment Distributor for a demonstration!

In only 11 seconds you dump the "65's" 19-ton load —with 3-stage, double-acting, constant-power hoist! Positive up-and-down snubbing guards against impact!

International® Construction Equipment

International Harvester Co., 180 North Michigan Avenue

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom-Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

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NOVEMBER 30-DECEMBER 5
INTERNATIONAL
25
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HOUSE, U.S.A.

INTERNATIONAL HARVESTER COMPANY
180 NORTH MICHIGAN AVENUE • CHICAGO 1, ILLINOIS

An open invitation to profit-conscious contractors

At Open House, U.S.A., you won't be viewing "just another big tractor." Not on your life!

This is the big, new International TD-25's "coming out party." And the "25" is coming out "loaded for bear!"

At Open House, U.S.A., you'll preview a king-sized crawler that has more proven, high-output exclusive features than anything else on tracks...The new TD-25 is:

—the only king-sized crawler powered by the new 230-hp, 6-cylinder, direct-start DT-817 diesel—loaded with capacity-adding, life-prolonging features no other engine has!

—the only king-sized crawler with world-proved Planet Power steering, that gives you fingertip power-steering and Hi-Lo, on-the-go power-shifting. Full-time "live" power on both tracks adds payload capacity as no other crawler can!

—the only king-sized crawler with International-developed double-box-beam track frames, the industry's strongest; the only one carried on Dura Rollers—the rollers you can power-lubricate without affecting seal life or efficiency —the ones that make 1,000-hr lube checks practical!

—the only king-sized crawler with so many far-ahead features it can outearn competitive rigs up to 50%, on an amazing variety of tough jobs!

Watch for the word on when and where your Distributor will hold TD-25 Open House, U.S.A. And be there, for sure. Be one of the first to size up the profit-making advantages of the big, new International TD-25.

More productive power to you!.

International Harvester Company

International® Construction Equipment

International Harvester Co., 180 North Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

JOY-HAZEMAG

IMPACT CRUSHERS

20 MODELS—5 TO 500 TPH CAPACITY

SELECTIVE CRUSHING WITHOUT EXCESSIVE FINES

Iron Ore • Asbestos Ore
Limestone • Coking Coal • Marble
Salt • Gypsum • Slag

Joy-Hazemag Impact Crushers provide selective crushing of a wide range of materials with efficiency and economy. By adjusting the position of the impact plates and varying the rotor speed, material is crushed in a controlled spectrum of sizes.

Typical Examples: Coking coal can be crushed to greater than 90% through ⅛" while limiting fines (minus 100 mesh) to a minimum; Limestone for fluxing can be crushed to a maximum grade product in a one-pass reduction to minus ⅛" plus 100 mesh; Hard and soft parts of conglomerate can be crushed to different sizes in one pass, for recovery of mineral values in one fraction by a scalping screen.

Write for full information on how Joy-Hazemag Impact Crushers can give you better crushed material at lower cost.

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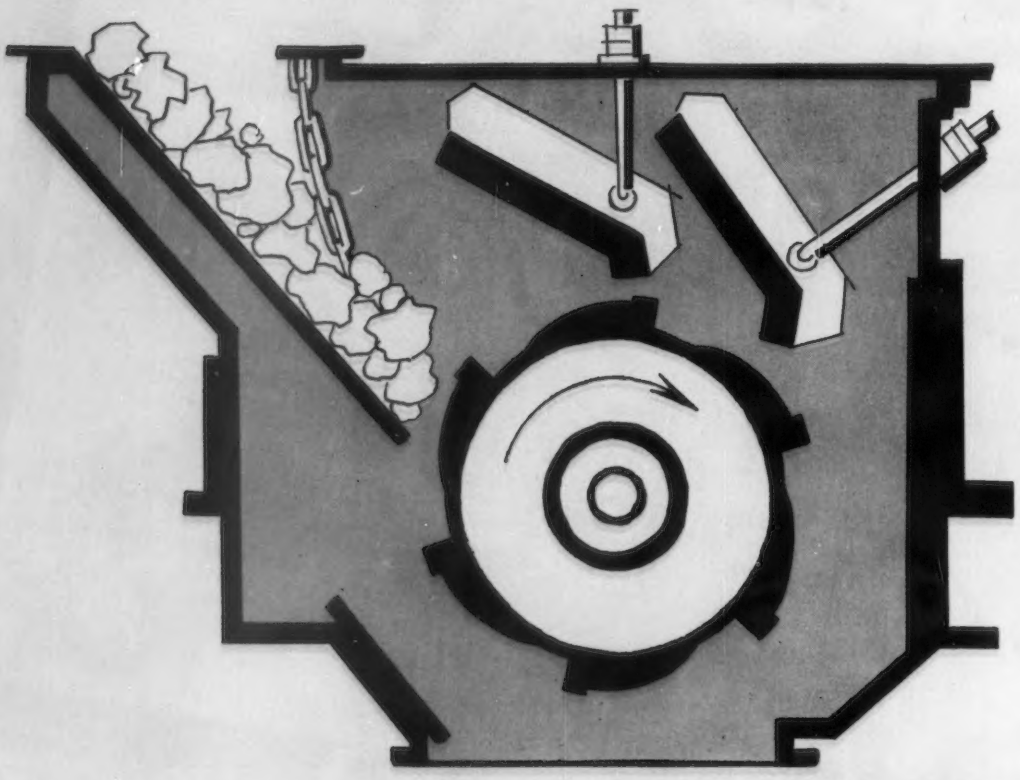
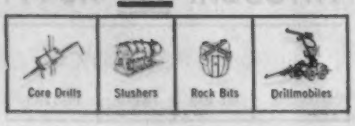


EQUIPMENT FOR MINING . . . FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.
In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

BROWNHOIST BRIDGE CRANE MOVES 700 TONS of material EVERY HOUR for Large Canadian Steel Mill

213

This fast-operating storage and rehandling bridge is one of 3 Brownhoist bridge cranes used in the Blast Furnace Department of one of the largest steel mills in Canada. Controlled from a man-riding trolley, the crane, equipped with an 8 ton ore bucket, requires only 40 seconds per trip to haul 700 tons of iron ore, limestone or coke per hour!

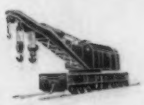
Bridge span is 225 feet and 364 feet overall. Cantilevers are 86 and 53 feet, while the crane measures 63 feet from foundation rail to trolley rail.

Relied upon for high-speed, high-capacity materials handling, Industrial Brownhoist bridges and boat unloading equipment are found in mines, quarries, docks and steel mills throughout the world. Brownhoist also manufactures Diesel-Electric locomotive cranes from 25 to 90 tons and railroad cranes with capacities up to 250 tons.

Write for general catalog No. 562; it contains complete information on profitable Industrial Brownhoist equipment.

BROWNHOIST

CLAMSHELL BUCKET


250 TON WRECKING CRANE

COAL-ORE BRIDGE

CAR DUMPER

LOCOMOTIVE CRANE

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AC and DC

Westinghouse motors are job-proved for all mining application

Regardless of whether you need a-c or d-c motors . . . regardless of the particular application . . . you'll find there's a Westinghouse motor to do the job . . . a motor which has proved itself time and again for rugged dependability and long operating life.

Combining the most modern materials with proven dependability and durability, Westinghouse motors will help you increase production through more efficient service . . . will help you decrease capital investment by giving you many extra years of reliable performance.

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YOU CAN BE SURE... IF IT'S Westinghouse

Giant capacity with typical Mack performance advantages

NEW MACK 40-TON DUMPER

Mack's new LYSW Model is engineered and built to handle 40-ton loads of ore and rock with greatest performance and at lowest cost. Whether in strip mine or quarry service, this rugged addition to the Mack line brings traditional Mack performance to the most formidable hauling jobs. Operators net more tons per dollar because no other truck can match Mack's long operating time of life under the most demanding conditions.

Powered by a 450 hp Cummins diesel engine, this 6-wheel-drive, 6-wheel end-dumper, with its 8-speed Powergear transmission, air assist clutch, or optional Torque-converter drive, has the ability to easily haul the biggest loads and at the same time provide unequalled handling ease and safety.

Mack quality shows up on the LYSW wherever you look. Axles and axle housings made by Mack are unmatched for sheer strength and durability. Mack-built transmissions are noted for dependable performance and long life because of their drop-forged, case-hardened gears and oversized shafts and bearings. Even the cab, with its heavy-duty all-steel welded construction bears the unmistakable stamp of Mack quality – as does the exclusive design of the driver's seat, unquestionably the finest offered for the man behind the wheel.

Let your Mack branch or distributor explain the many new and unique advantages of the LYSW Model. When you get the facts, you'll be convinced that an investment in a Mack makes sense from the start. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd., Toronto, Ont.

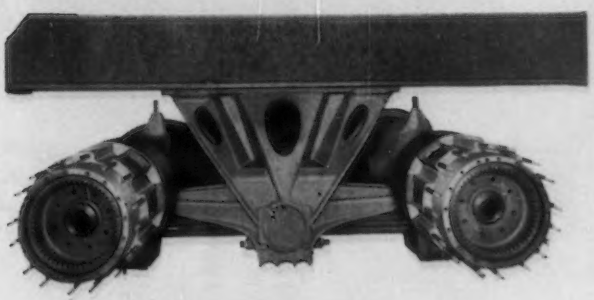
7140

MACK
FIRST NAME FOR
TRUCKS

In grueling, long experience on the Mesabi Range, the new LYSW 40-tonner has responded easily to every demand made upon it... **SO MUCH SO, THAT THE DEMAND BY THE INDUSTRY FOR THE MACK LYSW HAS EXCEEDED ALL FORECASTS.**

New radial-type maximum contact brakes are of latest air-over-hydraulic aircraft-type design. Positive braking control regardless of load is provided by use of 12 equally spaced blocks on each brake, activated by simple, positive, self-equalizing air-hydraulic system. The air-hydraulic rotochambers for each wheel are mounted inside frame for complete and safe protection. A set of internal expanding air brakes on the front wheels and a powerful hand brake working against the drive shaft complete the LYSW's braking system.

New alloy-steel frame on the LYSW Model is **stress relieved.** This assures a minimum of localized stress concentration with an extra wide margin of safety. The frame is built with tremendous strength and endurance factors which enable it to handle the heaviest loads and, at the same time, shrug off shock and vibration. I-beam side rails of heat-treated alloy steel have exceptional strength and stiffness (section modulus of 138), and the massive X-construction over the bogie ensures freedom from bending, wracking and twisting.

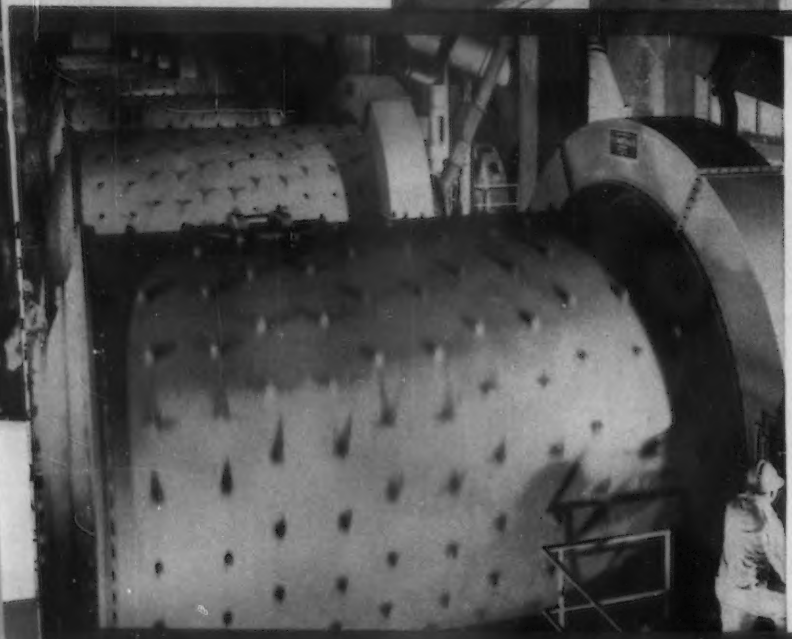


Newly designed Mack Balanced Bogie on the LYSW offers the strength and simplicity of straight-through drive and single-reduction carriers with Mack Planidrive reduction in the hubs. Exceptionally long tire life is achieved through unusual bogie flexibility which also reduces twisting and wracking of the frame. Even with diagonally opposite wheels raised more than a foot each, this flexibility keeps all wheels equally loaded and the frame level as shown. Mack's exclusive walking-beam suspension results in longer spring life by relieving springs of shock loads. And Mack's exclusive Power Divider directs power to the wheels having traction.

SMIDTH

rotary kilns

For sintering, nodulizing, calcining, desulphurizing, oxidizing and reducing roasting. Coolers, precoolers, preheaters, recuperators.
Auxiliary equipment for Rotary Kiln Plants.



grinding mills

Ball mills, tube mills and multicompartment mills—open or closed circuit—wet or dry grinding.
Also airswept for grinding and drying.
Over 1250 Smidth Rotary Kilns and over 5000 Grinding Mills supplied all over the world.

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42 Queen's Road
Bombay, India

8 miles of Bethlehem rope in aerial tramways. These continuous tramways, containing approximately 8 miles of husky Bethlehem wire rope, are used in the rock disposal system at the coal preparation plant of Omar Mining Company, at Stirrat, W. Va. Rated at 250 tons per hour, the system crosses a mountain to reach the disposal area. The loaded track cables use four pieces of 1¼ in. 1 x 61 extra high-strength tramway strand; the empty track cables have four pieces of ¾ in. 1 x 19 extra high-strength tramway strand. The traction ropes are 1¼ in. 6 x 19 type U preformed improved plow, lang lay, with independent wire rope core.

In this application, as in so many others, Bethlehem wire rope is relied on to give long service. Top quality in every detail, Bethlehem ropes are available in all popular sizes and constructions.

Bethlehem Steel Company, Bethlehem, Pa. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem wire rope

BETHLEHEM STEEL

THE BETTER WAY

The P&H way—"the better way" of design and construction puts P&H Electric Shovels in a class by themselves—they alone are not essentially the same as the shovels of a generation ago.

P&H has always been the pioneer developer of dramatic new designs and processes—this is why P&H Electric Shovels incorporate design fundamentals which make them different from all others. By their pioneering, P&H found "the better way" to production premiums as high as 10%, lower unit cost and more net profit for P&H owners.

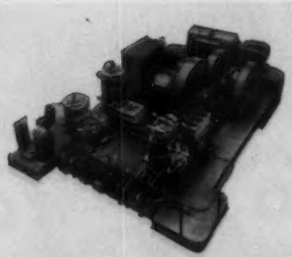
Some exclusive P&H design fundamentals not found in other electric shovels are:

1. ELECTRONIC CONTROL

This patented P&H control accomplishes the quickest work motion reaction time known for electric shovels. Control maintenance expense is reduced as much as 80% by elimination of all moving parts for a completely closed circuit system.

2. MAGNETORQUE® HOIST DRIVE

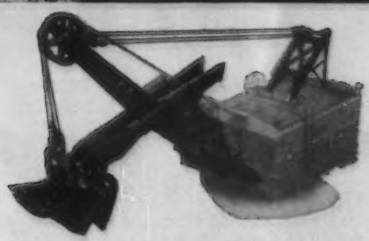
This patented hoist drive electro-magnetically transmits the full digging power of an A.C. motor direct to the dipper without motor generator set conversion to D.C. current! It gives up to 30% higher bail pull for more uniform digging speed and greater dipper fill factor.



3. FULL WELDED STEEL CONSTRUCTION

P&H was the originator of electric shovel construction by the unit welded rolled steel method. Their accumulated wealth of experience pays P&H owner dividends in the form of exceptional long shovel life in hard digging—accomplished by full welded steel construction.

"P&H is now the world's largest builder of full-electric and diesel-electric shovels. Only P&H manufactures their own electrical as well as mechanical components—designed specifically for electric shovel service—gives you the service assurance of single source responsibility."



4. ENCLOSED HOIST MACHINERY

Only on the P&H Shovel is all deck machinery—the power trains for hoist, swing and propel drives—enclosed in oil tight gear cases. No open gearings! Modern power train design at its best!

5. INDEPENDENT CRAWLER PROPEL MOTOR

Only P&H Electric Shovels have an independently motored crawler propel drive. P&H gives shovel owners the advantages of independent motoring—the basic principle of electric shovel design and purpose. The P&H is FULL-ELECTRIC in every work motion.

6. T-1 STEEL... SHOVEL ATTACHMENT

Only P&H furnishes as standard a boom and dipper handle fabricated of ultra high strength T-1 steel for high impact absorption ability, especially important in sub-zero temperatures. P&H pioneered and is the most extensive user of rolled alloy steels.

P&H MINING EXCAVATORS

OUR 75TH YEAR

HARNISCHFEGER CORPORATION • Construction & Mining Division • Milwaukee 46, Wisco

P&H LINE

Full-Electric and Diesel-Electric Shovels & Draglines: 3½ through 10 yds.

Diesel Excavators: ½ through 3½ yds.

Truck Cranes: 10 through 80 tons

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Texaco Simplified Lubrication Plan

you're using more than six lubricants for your major
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lysis of your total needs. With this over-all picture
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Your nearest Texaco Lubrication Engineer can give you complete information on the Simplified Lubrication Plan. Just call the nearest of the more than 2,300 Texaco Distributing Plants, or write Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

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Throughout the United States
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BRICATION IS A MAJOR FACTOR IN COST CONTROL
(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

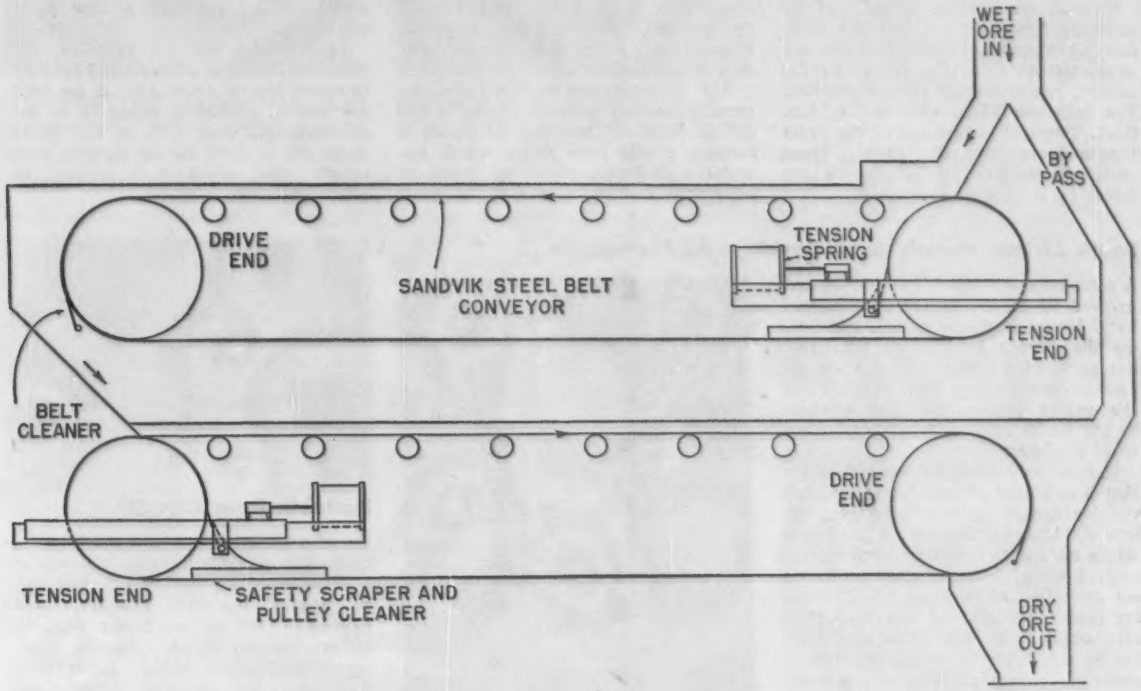
Full-Electric and Diesel-Electric
Shovels & Draglines: 3½ through 10 yds.

Diesel Excavators:
½ through 3½ yds.

Truck Cranes:
10 through 80 tons

NEW PRODUCTS DIGEST

In this issue—infrared heat used to dry uranium samples, an ac locomotive from South Africa, a portable lubrication rig, a sampling vacuum pump, General Electric's translucent ceramic refractory that is related to sapphire, a hill-walking, wall-climbing off-highway vehicle from Switzerland called the Flex-Trac, throw-away carbide bits and many new literature notices.

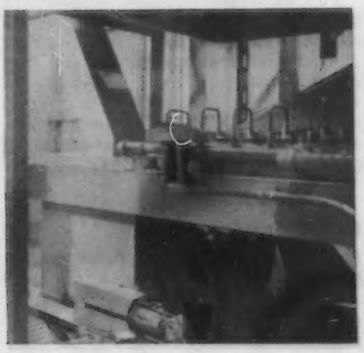


STEEL BELT dryer at Susquehanna Western, Riverton, Wyo., needs no cleaning after each sample run; as soon as one batch is completed, another run can start. The conveyors carry the sample beneath two parallel infrared heating units.

Infrared Dryer With Moving Steel Belt Dries Sample At Susquehanna Western (1)

SUSQUEHANNA WESTERN, INC., Riverton, Wyo., dries uranium ore for sampling by means of a unique double-decker dryer incorporating 54 radiant heating heads and two steel belt conveyors. The steel belt dryer eliminates the need for one or more rotary dryers which in this case would require cleaning after each batch since contamination of one ore sample by another would negate subsequent laboratory tests. Cleaning the rotary dryer is a hot, uncomfortable and time-consuming job and would either delay production or require more than one dryer, an excessively expensive alternative. This limitation does not exist with the steel belt dryer and no clean up is necessary; as soon as one batch is completely run through, the next can be started.

FEED END of upper belt starts drying run. Belt and ore feed can be varied.



DISCHARGE END of lower belt has hydraulic device to correct belt tracking.

Ore is brought to an elevated loading hopper by bucket elevator and is fed from the hopper in an approximately 1-in. thick layer to the upper steel belt conveyor. The conveyor carries the ore beneath two parallel infrared drying units running lengthwise of the conveyor, each drying unit comprising 13 heads and located some 10 in. above the ore. The steel belt, supplied by Sandvik Steel, Inc., travels at 1 to 6 fpm and discharges into a chute at the far end of the conveyor. Both conveyor speed and thickness of the ore on the belt may be varied depending on moisture content, which ranges from 2 to 15%.

The chute from the upper conveyor deposits the load on the lower conveyor, which runs in the opposite direction. The lower conveyor also carries the ore beneath two dryer units and empties into a chute at the discharge end. The discharge end of the lower conveyor is directly under the loading end of the upper conveyor. A by-pass

chute leads from the loading hopper to the lower belt discharge chute so that the entire dryer can be by-passed if the moisture content is in the 2% range.

Moisture evaporated from the ore is exhausted via hoods and ducting to atmosphere. Exhaust hoods are triangular in shape, about 4-in. thick, and are located centrally between the heater units. The dryer can evaporate 250 lb of water per hour.

Over-all ore handling capacity of the dryer is 2,500 lb per hr. The load-carrying strands of the conveyors are supported on 6-in. idler rollers on 2-ft centers; return strands are unsupported. The belts are 32-in. wide and 0.04-in. thick. Terminal pulleys are of the drum type and are 36-in. dia, 17½ ft apart, center to center. The conveyors are driven by 8 hp motors.

Both conveyors are equipped with scrapers at the discharge ends. Upper surfaces of the return strands are scraped to keep miscellaneous material from between the belts and the pulleys. The pulleys in turn rotate against a scraper so that a particle not scraped off the return belt and caught between it and the pulley, is scraped from the pulley after one trip around.

The conveyors have built-in tensioning devices which operate regardless of contraction or expansion due to temperature changes under operating and non-operating conditions.

The conveyors are equipped with automatic tracking controls. Should a belt deviate from the true line of travel, it contacts a side limit switch which operates a hydraulic piston to move an adjustable bearing in which the shaft of the drive pulley is mounted. The bearing pivots the pulley slightly about the other bearing and returns the belt to the line of travel.

Belts are installed by threading them about the supporting members, pulling the ends together with a standard belt stretcher, drilling holes for rivets, and driving the rivets. Should a belt accidentally become torn or damaged in service, a length containing the damaged section is cut out and a new piece spliced in.

In preparing ore for sampling, the entire batch is first screened and crushed to minus 1½ in. About 10% of the total ore feed is crushed to minus ¾ in. for sampling, and then 10% of the minus ¾-in. ore is dried on the Sandvik conveyors, after which it is crushed to minus ¼-in. for assaying.

South African Manufacturer Develops AC Locomotive (2)

A RADICALLY new type of ac locomotive, evolved by G. W. Barnes of Johannesburg, Union of South Africa, and built by the Barnes Engineering Co., Ltd., has attracted a great deal of attention. The locomotive was built recently for the golden jubilee exhibition arranged by the South African Institute of Electrical Engineers.

Unique features of the locomotive are that it is wholly ac, can run at infinitely variable speeds in both directions, inherently brake regeneratively, and that all its normal functions of starting, running, braking, stopping and reversing are controlled without switches or braking resistances, and by the movement of a single lever. The locomotive built for the exhibition is a compact vehicle about 8 ft long running on a 24-in. gage track, with a trolley-pole collecting current from an overhead wire. In addition to the driver's seat it has a bench to accommodate three passengers. On the dashboard is a headlight switch, a horn button and an ignition switch.

The single control lever is handy to the driver's seat. With any setting of the control lever the locomotive maintains practically the same speed uphill and downhill, making almost no concession to gravity or load. The motor automatically draws more current when ascending; descending, it automatically feeds current back into the mains and drives the supply meter backwards. For braking, the lever is simply reversed. The regenerative braking is powerful enough to make a mechanical brake redundant except for safety purposes. Much of the energy used in acceleration is stored in the machine and later returned to the mains by the braking.

Portable Lube Rigs (6)

TO SERVICE machines and earthmovers on-the-job, portable lubrication rigs have been designed by Cypher Co. that can be installed on small pick-ups, large flat-bed or enclosed van trucks. Portable system includes an air compressor, six air-operated drum pumps (with both high and low pressure types) and lengths of hose. Rigs can be equipped to dispense motor oil, gear oil, light or heavy grease, track and roller greases.

Billet Grinder (3)

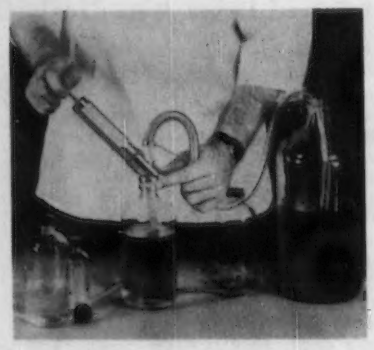
PORTABLE, semi-automatic billet grinder has been patented by Ty-Sa-Man Machine Co. which takes billets or slabs up to 12 in. wide by 12 in. thick in lengths to 20 ft. Patented angled wheel is driven by a 40-hp motor.

Power-Packed AN Explosive (4)

COMBINING the low cost feature of processed amonium nitrate with the handling ease and controlled shooting of regular explosives has produced a new explosive for Atlas Powder Co.—Apcomite. Explosive produces more power per foot of loaded blast hole than on-the-job AN. Also, Apcomite has a primer installed. Apcomite 17 is for normal usage, while No. 20A is for wet holes. Both are furnished in 23G tubes in 5-in. (and larger) diameters.

Control Concentration (5)

AN AUTOMATIC electronic solution controller system has been developed by Electro Mechanisms Corp. for controlling the concentration of caustic, acidic or aqueous solutions. System consists of a concentration-level control setting, a sensing electrode which measures concentration, a magnetic amplifier which controls a pump assembly that delivers concentrated feed solution to a tank.



Sampling Vacuum Pump (7)

ACCORDING to S. Anton Wladis, president, Fred H. Ebersold, Inc., Model D sampling device can sample powdered solids that have a tendency to lump or seek their own level, as well as liquids up to the consistency of syrup. Pump is designed so that the sample never comes into contact with the pumping parts to prevent contamination of the sample or corrosion of the pump. Pump is made to fit neck-opening sizes from 22 mm up to wide-mouth Mason jars.

TRANSLUCENT ceramic made from dense alumina will find many markets.

CERAMIC supports 50-gm weight at 2350° F while unloaded quartz bends.

Translucent Refractory Developed With High Strength (13)

A POLYCRYSTALLINE ceramic that readily transmits light has been fabricated from powders by General Electric Co. In addition to transmitting light, the new material possesses the extremely high strength characteristic of alumina ceramics, can withstand much higher temperatures than most ceramics now in use, and can be pressed into any shape desired. "No other material combines translucence with this degree of strength, heat resistance, and ease of fabrication," says GE.

The basic material of Lucalox, as the new material is called, is fine-grain, high-purity alumina. The powder is pressed at room temperature, then fired at temperatures that are higher than usual for ceramics.

Lucalox was first made by Dr. Robert L. Coble, of the General Electric Research Laboratory. Following his first research, important contributions were made by Dr. P. D. S. St. Pierre, Dr. Edward Stover, and Arno Gatti. The problems of making the process commercially feasible are being explored.

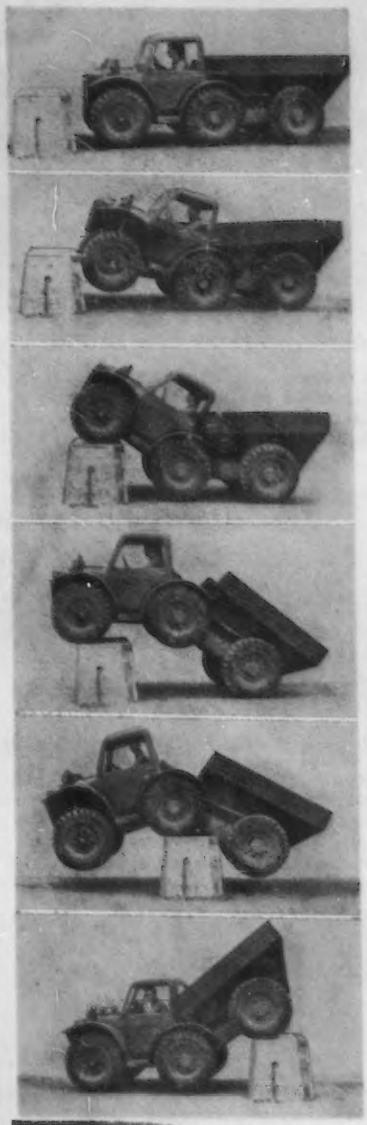
Lucalox is closely related to sapphire and ruby gem stones, which are single-crystal aluminum oxide, but GE's polycrystalline form of the same compound is said to be superior to the gems in its ability to withstand high temperatures (to 3600° F) without deforming. Lucalox has the composition of a ceramic, the structure of a metal, and the light-transmitting ability near that of glass.

The unique characteristics of Lucalox results from the fact that the microscopically small pores, or "bubbles," that are normally found in ceramic materials have been entirely removed, a feat that had been previously considered impossible.

Because of the elimination of the pores, it is possible to read through a sheet of Lucalox when it is laid flat upon a piece of paper. At greater distances it appears translucent, resembling frosted glass. At least 90% of the light in the visible spectrum is transmitted through the new ceramic.

Polysulphide Exopy Resin Spray Reduces Corrosion (11)

A COATING of polysulphide liquid polymer and exopy resin has solved the major maintenance problem in fertilizer and chemical carrying railroad cars according to Thiokol Chemical Corp. Coating not only provides protection against corrosion but improves the abrasion resistance of the steel cars. Thiopox, supplied by Phelan Faust Paint Mfg. Co., is being used by North American Car Corp. (following three years of testing) to coat the inside and outside of gondola cars used in chemical and fertilizer service.



Flex-Trac Billy Goat (14)

ACCORDING to the Swiss journal, AUTOMOBIL REVUE, No. 53, December 1958, Berne, Switzerland, walls are no longer an obstacle, nor ditches, ravines or hills, to a radically new kind of off-highway vehicle called the Flex-Trac. The all-wheel drive machine is the product of E. Meili, Schaffhausen, Switzerland and has front and rear wheels which pivot independently of each other on guide arms. Also the front and rear of the vehicle may be moved vertically around a central transverse axis. The Flex-Trac's front wheels can be operated as a unit or independently. The front end of the vehicle can be lifted while in motion. The vehicle can move along a hillside with the body remaining in a horizontal position.

International Harvester has added a Mobile Drilling Co. 8-40 Explorer (diamond and auger drill) to its line of optional equipment for the TD-9 and TD-6 crawler tractors.

Goodman Loader For Potash, Gypsum or Coal (8)

GOODMAN MFG. CO. has added a 38-in. loader for intermediate and higher seams of coal, potash and gypsum. Type 967 has rated capacity of 15 to 20 tpm and has a 30-in. conveyor, a 2¼-in. pitch conveyor chain, 4½-in. ground contact on the 12-in. treads and four motors (21 hp dc or 26 hp ac).

Jumbo Screw Feed Mounts 5½-in. Drills (9)

SCREW FEED mount offered by Gardner-Denver Co. mounts 4½- and 5½-in. percussion drills for tunnelling jumbo work. Units are operated by remote control and the controls can be mounted almost anywhere desired. Series 2MC screw feed is fitted with a L015A line oiler for the drill, feed motor and screw feed bearing. The feed screw is lubricated by the drill exhaust.

Self-Propelled Power Plant Packs up to 250 kva (12)

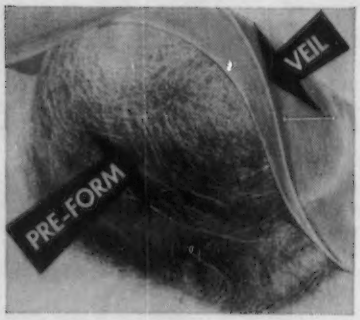
POWER PLANT developed by Stewart & Stevenson Services, Inc. for airline plane service has been introduced to the mining industry as a highly maneuverable, low-slung unit that can go anywhere an ordinary vehicle can go. Packed power ranges from 30 to 250 kva with either a General Motors or a Chrysler industrial diesel engine. Electrical output is 60 to 400 cycle ac with auxiliary dc service. Unit can also supply hydraulic or air power, or both.

Tough Truck Tire (13)

A TRUCK TIRE being marketed under the U.S. Royal Super Fleetmaster Safety Steel Shield trade name makes use of a multiple ply of nylon cord and steel cable to protect against blowouts and cuts. Acording to U.S. Rubber Co., the tire is 20% more expensive than rayon cord tires but more than makes up the difference in cost by improved performance and reduced maintenance. Sizes available range from 7:50-20 to 11:00-24 in tube and tubeless designs.

Blast-Hole Drill Rig (15)

A SWING BOOM AIR-TRAC all-purpose blast-hole drilling rig especially suited to rough terrain has been introduced by Gardner-Denver Co. Model ATD-3000 swing boom Air-Trac has several innovations: drilling can be done over the side of either track in an 11-ft 10-in. swing arc—more holes from a set-up; and the swing boom (which mounts either a 4- or 4½-in. drill) is adaptable for low horizontal, angle or breast-hole drilling up to 9½ ft above ground level.



Plastic Hard Hats (10)

IN ADDITION to an all-plastic adjustable suspension unit in the hat, the Superglas hats and caps of Fibre-Metal Products Co. has an added safety factor (which also improves weathering and wear characteristics as well) in that a thin layer of fine spun glass fibers is placed near the outer surface of the hat's shell. The result is a thin layer of resin and glass near the surface.

Sturm Brett

Edward Sturm and Willis H. Brett have formed Sturm & Brett Engineers, Inc., 222 West Adams St., Chicago 6, Ill. Sturm formerly worked with International Minerals & Chemical Corp. and Vern E. Alden Co., while Brett is late of Western Knapp and Barber-Greene.

For Your Files

This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

OPTICAL TOOLING and industrial alignment equipment catalog from Keuffel & Esser Co. lists all the tools and accessories available. 25pp. **(60)**

DETAILS of Brunner & Lay, Inc.'s new line of rope-thread blast hole drilling tools are included in a revised complete line catalog (759) 12pp. **(61)**

BLAST electrically—get better results with less cost—is the theme of Atlas Power Co.'s HANDBOOK OF ELECTRICAL BLASTING. Comprehensive. Illustrated. **(62)**

MINE RESCUE equipment catalog from Mine Safety Appliances Co. offers complete details on M-S-A Porto-Power hydraulic equipment (0911-1) 6pp. **(63)**

CAR SPOTTING equipment for use in positioning railroad cars at sidings can be examined through literature available from Hewitt-Robins, Inc. **(64)**

DETAILS of Bay City Shovels, Inc.'s CraneMobile truck-mounted crane are presented in a bulletin. 20pp. **(65)**

UNIQUE features of the Model 205 Skooper — a full-revolving, crawler-mounted front-end loader — are described in an eight-page bulletin (K-636). **(66)**

SHOVEL PARTS of tough alloy manganese steel from Kensington Steel are introduced in a four-page bulletin. Regardless of the kind or size of a crawler unit, Kensington can supply the wear parts. **(67)**

AN INFORMATIVE 24-page catalog (CR-601-1) from International Harvester Co. presents all the features of the new Model 295 Payscraper — a bowl scraper turbocharged to develop 375 for 34-cu yd heaped capacity. **(68)**

CRANE, clamshell, shovel, hoe or dragline—you name it—the new 18-ton Lorain rubber-tired Moto-Crane Model MC-218 will fit the bill according to an eight-page bulletin. **(69)**

PRODUCTION and mechanical advantages of the D9 series E tractor and the Power Shift transmission are included in a six-page brochure from Caterpillar Tractor Co. **(70)**

FOUR-WHEEL steering and four-wheel drive are just two features of the Napco Crab tractor—the tractor that will go in almost any direction—according to a four-page bulletin from Napco Industries, Inc. **(71)**

TRACTOR REPAIR PARTS — Tisco brand—from Taylor-Wharton Co. in work hardened manganese steels (see January New Products Digest plastic dynamite feature) are introduced in a four-page bulletin. Parts for many machine makes can be shipped from stock — Caterpillar, Allis-Chalmers, Eimco, International Harvester for example. **(72)**

CATALOG available from International Harvester Co. offers a look at the many features of the TD-9 crawler tractor. 16pp. **(73)**

SUBMERSIBLE pumps from Layne & Bowler, Inc. are shown in cross section in a four-page bulletin. **(74)**

ACCURATELY machined replacement parts for mining machinery can be obtained from Penn Machine Co. according to a 12-page bulletin. **(75)**

A NEWLY revised edition of Air Reduction's Aircomatic welding wire pocket guide has been prepared by Air Reduction Sales Co. Illustrated in 84 pages, the book includes all the latest information (ADC 873A). **(76)**

ENGINEERING literature on Allis-Chalmers Mfg. Co.'s line of single-stage scroll casing air compressors has been released (16B6048C). 12pp. Illustrated. **(77)**

SLIDING VANE single-stage rotary air compressor, the new Le Roi 75RGI (75 cfm at 100 psi machine) is powered by a gasoline engine according to a two-page flyer. **(78)**

DESIGN and construction engineers —C&M Industries, Inc. of Denver, Colo., have prepared an eight-page introduction to their talents and services. **(79)**

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McGRAW-HILL PUBLISHING COMPANY, INC.
ENGINEERING & MINING JOURNAL
330 WEST 42nd STREET
NEW YORK 36, N. Y.

E&MJ NOT GOOD AFTER MAY 1, 1960 **NOV. 195**

Please send me the catalogs or further information about the items from New Products Digest whose numbers are circled.

1	11	21	31	41	51
2	12	22	32	42	52
3	13	23	33	43	53
4	14	24	34	44	54
5	15	25	35	45	55
6	16	26	36	46	56
7	17	27	37	47	57
8	18	28	38	48	58
9	19	29	39	49	59
10	20	30	40	50	60

61	65	69	73	77	81	85	89	93	
62	66	70	74	78	82	86	90	94	
63	67	71	75	79	83	87	91	95	
64	68	72	76	80	84	88	92	96	1

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FOR THOSE hard-to-handle fluids—corrosive, abrasive, viscous, thick, heavy, quick-setting, valuable, or hazardous—the Shriver diaphragm pump may be the answer to lower cost, better operations, according to T. Shriver & Co., Inc. four-page bulletin (148). 4pp. **(80)**

RESISTANCE elements for the measurement of temperatures to 1,200° F under pressures to 4,500 psi are described in a four-page product specification sheet (E51-6) from Bailey Meter Co. **(81)**

DETAILS of a helium-filled system for measuring temperature in the 0 to 1,200° F range are shown in a four-page product specification from (P51-4) Bailey Meter Co. **(82)**

HIGH STRENGTH steel—Allegheny Ludlum Steel Corp.'s Potomac A—containing chromium-molybdenum and vanadium alloying agents, is discussed in a 24-page bulletin. Potomac has high strength to 1,000° F. **(83)**

MECHANICAL features of the 36-in. Allis-Chalmers Mfg. Co. Hydrocone crusher are described. **(84)**

SCALE-FREE gas-fired storage water heaters in the Patterson-Kelley Co., Inc. line are presented in a 19-page bulletin (4). Model 230 has many unusual features. **(85)**

CONTROL CENTERS that economize on space, simplify maintenance and provide maximum safety and operation control are featured in a 16-page bulletin (PL6200) on ac motor control centers from Clark Controller Co. **(86)**

HOW Panellit Service Corp. installs control instruments and system from design to plant start-up is the subject of a 15-page bulletin (107). **(87)**

DOW CHEMICAL CO. products catalog lists all the 375 industrial, pharmaceutical and agricultural chemicals produced by the company. 44pp. **(88)**

DECO TREFOIL for August-September 1959 takes an eight-page visit to Irish St. Patrick's Copper Mines, Ltd. in Avoca, Eire. Also see E&MJ May 1958. **(89)**

A STUDY of grinding ball wear employing a radioactive tracer technique—a paper by A. L. Wesner, M. Pobereskin and J. E. Campbell of Battelle and presented at AIME 1958 is available from Coates Steel Products Co. 11pp. **(90)**

BELT gravimetric feeder Model 37-20 from B-I-F Industries, Inc. is featured in a bulletin four-page (35.20-2). Feeding accuracy to ± 1% by weight are possible at up to and over 3,000 lb/hr. **(91)**

PACKAGED gas sampling equipment to meet any process demand can be had on request according to information furnished in an eight-page bulletin (59-B651) by Hays Corp. **(92)**

PRESSURE reducing valve—Atlas Valve Co. Type B—is a single-seat, tight-closure, self-contained, spring-loaded piston-operated, pilot-operated valve for use on steam, oil, air, gas or water handling jobs according to a four-page bulletin (section 1). **(93)**

MEN, METHODS & Machinery—Construction Aggregates Corp.'s story—is told in an illustrated 51-page bulletin. Projects handled or being handled by the company are discussed and the CAC hydraulic strip mining and dredging methods are presented. **(94)**

A SPRAY nozzle that makes a solid cone of spray droplets has been introduced by Wm. Steinen Mfg. Co. according to a data sheet. Nozzles are in the Tan-Jet line and come in a variety of sizes and capacities. **(95)**

ONSTREAM instrumentation with the AccuRay gamma radiation detector system is illustrated in a 12-page bulletin from Industrial Nucleonics Corp. AccuRay can determine bin or tank levels, density, container filling and can be made to control a process or respond to process controls. **(96)**

ALL THE METALS, meshs, weaves and widths of Newark Wire Cloth Co.'s line of screen cloth are introduced in a four-page bulletin. **(97)**

DISPOSABLE odor filter using activated carbon and offering low cost filtering is described in a four-page bulletin (220) from American Air Filter Co. **(98)**

A REPRINT from the JOURNAL OF METALS describing the HyL Process in detail (also see E&MJ October 1958, p150) is available from W. M. Kellogg Co. which recently announced that Cyrus Eaton interests would build a HyL plant in southwestern Ontario. 6pp. **(100)**

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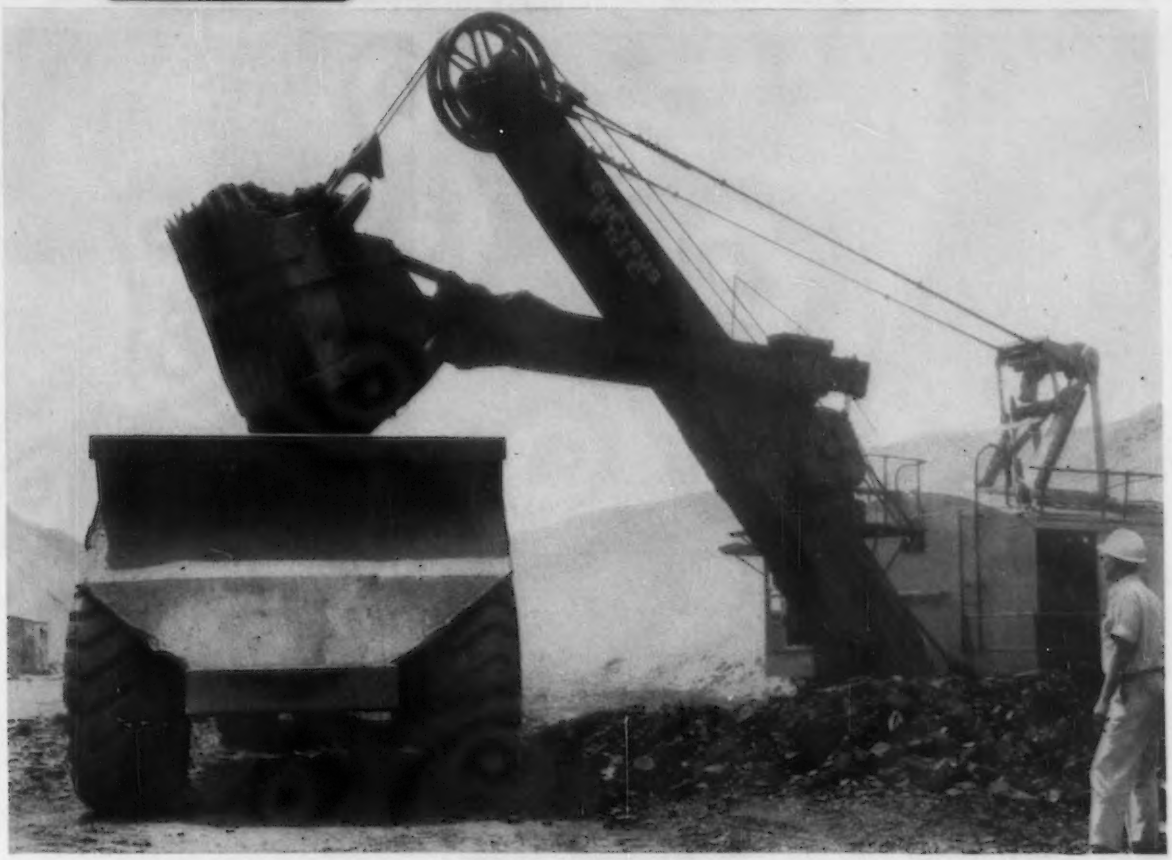
B.F.Goodrich



Those B.F.Goodrich tires haul 40 tons of coal over roads made of abrasive limestone

THE Buckheart Mine #17 near Canton, Illinois, is one of many strip mines operated by United Electric Coal Company. Here trucks with 40-ton coal capacity make continuous 8-mile round trips between pit and tipple. Roads are made of abrasive crushed limestone. This could be a real tire-killing job, but the company avoids this costly problem by using B.F.Goodrich Rock Service tires. In fact, B.F.Goodrich tires have been used at Mine #17 since 1938!

B.F.Goodrich builds extra service into the Rock Service tire 3 ways: (1) The tread is extra thick and specially compounded to resist rock cuts and snags. (2) Massive double-chevron cleats defy side-skids, give maximum traction in forward or reverse. (3) A FLEX-RITE NYLON cord body that withstands double the impact of ordinary cord materials. This B.F.Goodrich material resists heat blowouts and flex breaks and means more retreadable Rock Service tires and more retreads per tire.

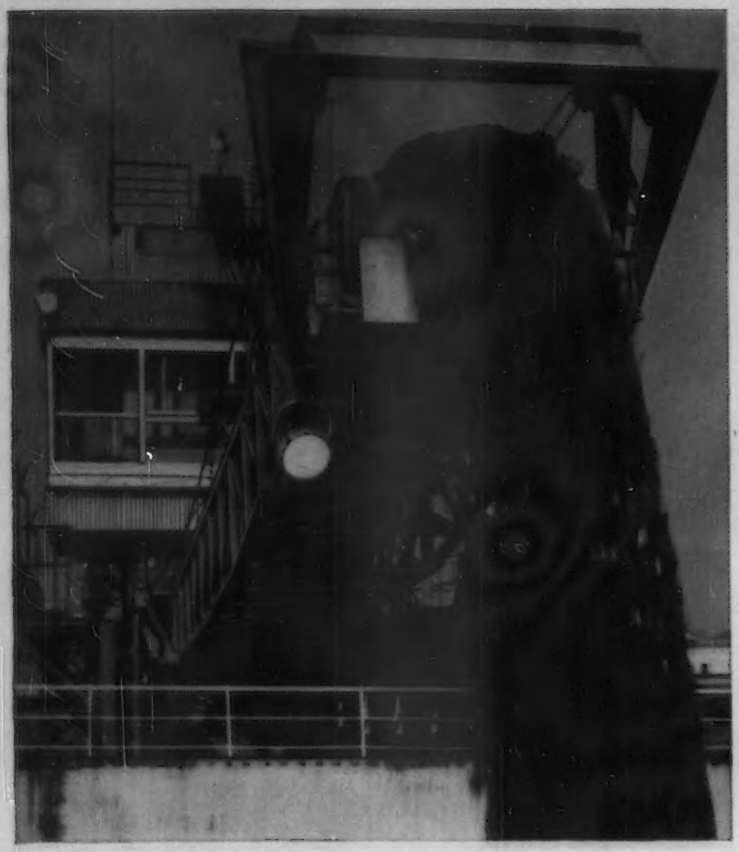
Follow the lead of successful mine operators. Switch to new B.F.Goodrich Rock Service tires and start saving. See your B.F.Goodrich Smileage dealer, who is listed under Tires in the Yellow Pages of your phone book. *The B.F.Goodrich Co., Akron 18, Ohio.*

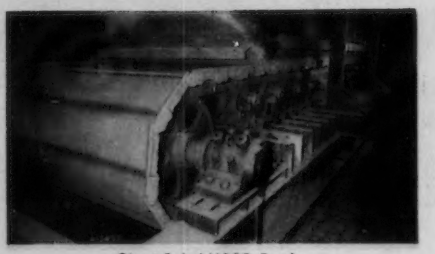
Specify B.F.Goodrich Tubeless or tube-type tires when ordering new equipment

Smileage!

B.F.Goodrich *off-the-road tires*

STEPHENS-ADAMSON





Giant S-A AMSCO Feeder

S-A Stockpiling Conveyor System

S-A Twin Shiploading System

FOR EFFICIENT, PROFITABLE ORE HANDLING

At the left, ore is shown pouring into a ship's hold at an average rate of more than 4,000 long tons per hour from one of two giant STEPHENS-ADAMSON boom conveyors at Sept. Iles, Quebec. The STEPHENS-ADAMSON equipped ship-loading facilities believed to be the largest capacity in the world — handles as many as seven ore vessels a day and nearly 10,000,000 tons of ore a year.

STEPHENS-ADAMSON is proud to have been selected to equip the ship-loading facilities and other ore handling operations of the huge Quebec-Labrador project — one of the most far-reaching construction projects ever undertaken.

Write for Literature on S-A Ore Handling Equipment.

S-A

ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT, 4 RIDGEWAY AVENUE, AURORA, ILLINOIS

PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

Why the "built-in values" of General Electric Mining Cables are so important to you

"Built-in values" make General Electric cables outstandingly successful in meeting the needs of the mining industry. These values result from designing, engineering, and building into these cables carefully developed and selected components and particular construction advantages.

Three examples of these important values are:

Two-layer reinforced lead-cured jackets. Here's how the jackets of G-E portable mining cables are made to resist abrasion, pulling, crushing, and twisting: 1) *Lead curing* gives a dense, tough jacket with added longitudinal and radial mechanical strength; 2) a strong, *twine open mesh* is built in as an integral part of the jacket to provide greater over-all tensile strength and radial strength in order to reduce displacement of the core members.

Flexible conductors that reduce breakage. Flexibility and long service life are achieved by special rope concentric stranding of conductors, developed through years of testing and field service.

Insulation with toughness and crush-resistance. Insulation for 600-volt cables, for example, is a GRS heat-resistant rubber compound with excellent electrical characteristics and the necessary mechanical toughness and resiliency for the severe conditions encountered in mining applications.

All General Electric mine cables bear the embossed symbol P-108 of the Pennsylvania Department of Mines, and where required also carry the BM marking indicating listing by the United States Bureau of Mines.

To get complete information about G-E mine cables, mail the coupon for new, up-to-date brochure.

Progress Is Our Most Important Product

GENERAL ELECTRIC

General Electric Company
Wire and Cable Department
Section W230-1195
Bridgeport 2, Connecticut

Please send me your new booklet on General Electric Portable and Power Cables for the mining industry.

Name_____

Title_____

Company_____

Street_____

City_____ Zone____ State_____

DOW | **CHEMICALS**
team up for greater profits

Recovery and ultimate profits rise when "tailor-made" chemical recovery agents enter the flotation picture. More and more mining operators have come to realize the tremendous value of the proper combination of these in flotation operations. Below are some nuggets of fact designed for quick, informative reading by the profit-minded process engineer.

You may wish to check certain items in this advertisement and forward to those concerned in your company.

ROUTE TO:

_____

_____

_____

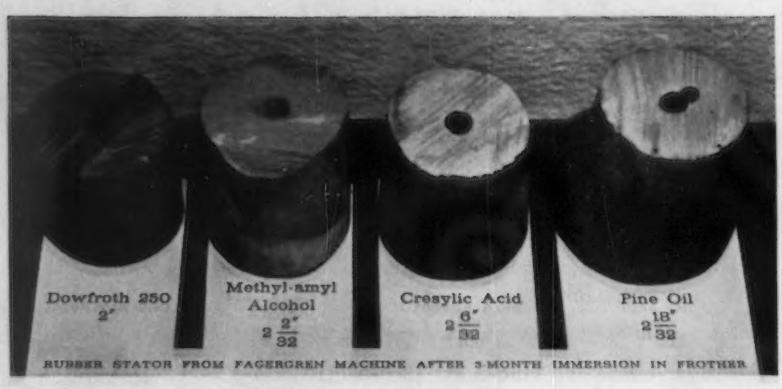
_____

CHEMICALS JOIN FORCES FOR WIDE-RANGE RECOVERY

Here's a chemical team of flotation recovery agents which, together with a first-rate frother, do a man-sized job of quickly separating wanted minerals from gangue and unwanted minerals, improving concentrates, lowering costs and greatly increasing the efficiency of flotation processing.

Long used as standard sulfide mineral collectors, the nine Dow Xanthates play an increasingly important role in flotation recovery. As the gap narrows between costs and profits, new processing materials and methods become of prime interest to operators who wish to see profits return to the profit side of the ledger! Flotation research being carried out by Dow metallurgists and chemists shows how various combinations of Dow flotation chemicals can help operators to do just that!

A good example of teamwork among Dow's reagents is found in the flotation of copper minerals. A combination of Z®-200 and Z-11 plus Dowfroth® 250 is particularly effective for a wide variety of copper ores. Z-200 is highly selective and Z-11 adds its specific collecting properties to "backstop" the activity of Z-200. The results are higher grade concentrates, better metal recovery and increased economy in processing. An additional advantage of this reagent combination is that it eliminates the need for a continual inventory of many different reagents, while at the same time it provides high collecting power for virtually all of the sulfide copper minerals which may be processed.



Dowfroth 250 minimizes damage to rubber covered equipment.

It's well worth noting that Z-200, the newest of Dow flotation collectors, exhibits outstanding copper-iron selectivity, floating almost no free pyrite in lime alkaline pulps above a pH of 9.5.

Dowfroth 250, the third member of the trio above, is a powerful, noncollecting frother for *both* sulfide and nonsulfide minerals. It is completely water soluble. Its noncollecting power means that engineers can easily regulate frother and collector independently. Then there are the twin economies in maintenance and in cost-of-use. Since Dowfroth 250 is much less reactive with synthetic and natural rubbers than most of the other commonly-used frothers, rubber covered equipment such as stators, impellers and pumps are less often down for repair. Dowfroth 250 virtually pays its own way, too! It's effective at one-fourth to one-third the quantity required of other frothers, with resulting savings in frother costs and in storage space.

Dow research chemists are experienced in flotation chemistry, but they're constantly learning new tricks and new techniques in the more efficient application of recovery reagents to mining processes.

For the latest word about these techniques and the chemicals involved, send for a copy of the extremely interesting book "Flotation Fundamentals". Its 107

pages are packed full of facts and information that will prove highly profitable to *your* operations.

FLOCCULATION
Settles problem suspensions

Mining metallurgists who have been faced with problems in liquid-solid separations have had graphic proof that an effective answer to their problems can be achieved with the use of Separan® flocculating agents. These polyacrylamide-type settling agents adsorb onto the surface of minute suspended solids and settle them out quickly—often at hundreds of times the untreated settling rate.

By using Separan NP10, for example, one uranium processor planning a new facility recently eliminated from his plans four of the five thickeners, two banks of filters on the underflow from these thickeners and several impounding dams. The savings in the revised operation alone amounted to several thousand dollars per day, and at a cost of only a few dollars per day for Separan.

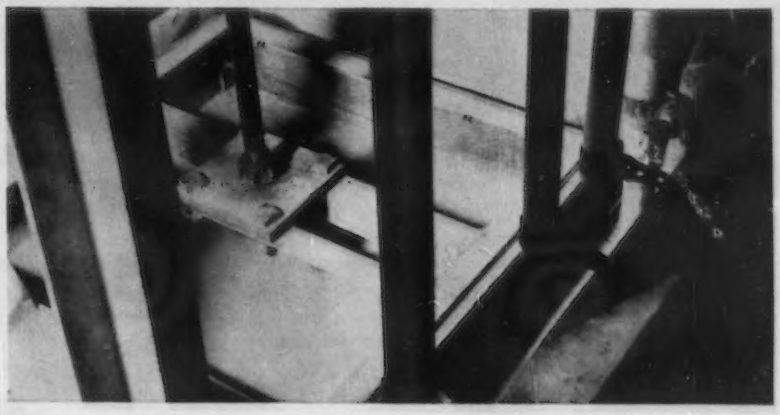
At present Dow's family of flocculating agents already have a long history of success. Each situation will determine which member of the family will do the best job for you. And in every case they are backed by fully experienced Dow technical men. When it's a question of liquid-solids separation, these men are anxious to be of service to you.

ION EXCHANGE
Recovers, separates, and concentrates metals

The process of ion exchange has made a mark for itself in many different fields, particularly where extremely valuable metals, such as uranium, are being recovered. The pregnant solution contacts a bed of ion exchange resins. The metal ions are concentrated in the resin beads and can then be readily recovered.

The profitable use of ion exchange resins is indicated when: (1) metal values are being recovered by less economical methods; (2) metal values are being lost; or, (3) recovery of metal values is economically impractical by other processes.

Dow's dependable family of Dowex® ion exchange resins is fast becoming a standard tool for copper recovery, columbium and tantalum recovery and separation, and molybdenum recovery. And Dow's skilled ion exchange technical team is ready to give you a hand when you need it.

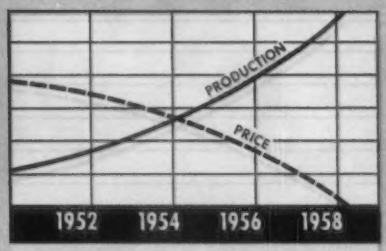


Ion exchange applications are proved out at Dow laboratories under simulated actual field conditions.

If you'd like to know more about any of the chemicals discussed here, or about the many other Dow mining chemicals, write THE DOW CHEMICAL COMPANY, ***Midland, Michigan, Chemicals Merchandising Department 935BD11.***

ON THE MINING CHEMICAL NEWSFRONT

MAGNESIUM HYDROXIDE
New idea in precipitants... more reactive, freer flowing, does not lump in storage. Uranium processors now using.



CHELATING AGENTS
The family of Versene® products offers the mining industry the most complete line of chelating agents. Efficient and economical to use as filter cloth cleaner and descaler.

MURIATIC ACID
New! Fact-filled handbook about Dow muriatic acid. A "must" for everyone concerned with improving mining process operations.

CAUSTIC SODA
86-page caustic soda handbook puts a wealth of NaOH information in compact, useable form. Gives all the information about this essential chemical.

DOW CHEMICALS ***basic to the mining industry***

Flocculants • Ion Exchange Resins • Preservatives • Chelating Agents
Ammonia • Solvent Extractants • HCL • Frothers • Chlorine • Calcium Chloride
Alkalies • Flotation Agents

THE DOW CHEMICAL COMPANY
Midland, Michigan

DOW

Has no springs, rides on Hydrair®

metal mining modernization

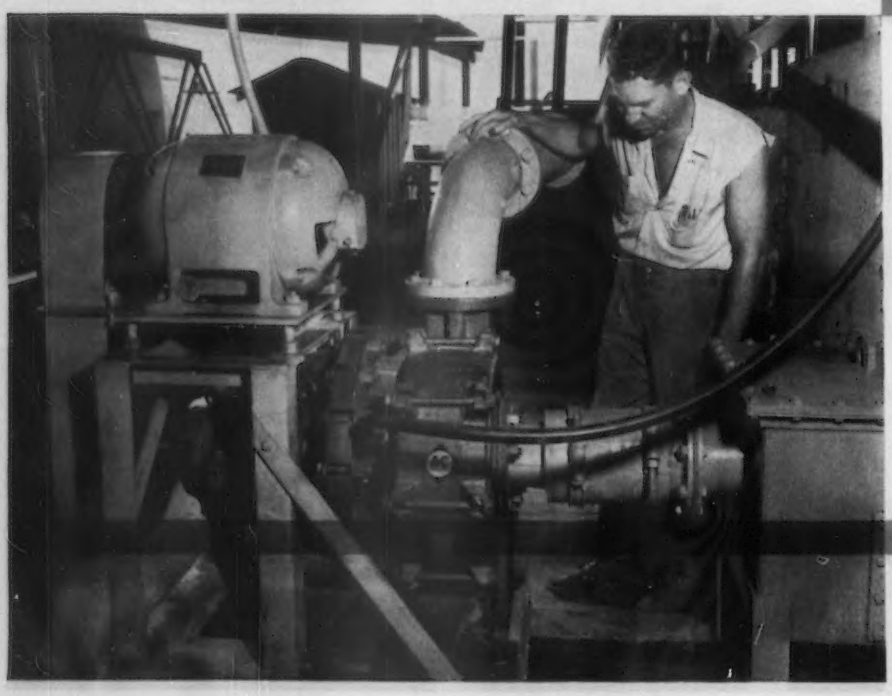
Boost pump life 1000 to 5000% with Allis-Chalmers rubber-lined pumps

Case histories show 10 . . . 30 . . . even 50 times greater pump life for users who modernize by switching to Allis-Chalmers rubber-lined pumps. Tailor-made for handling abrasive slimes and slurries — and here's why:

- All wetted parts including casing, casing side plate, and impeller are protected by dense, tough, wear-resistant rubber compound.
- Special rubber compounds are used to resist wear of even such abrasive slurries as taconite and silicon carbide.
- Casing liners are pressure molded to steel frames, thus combining the rigidity of steel with the resilience of rubber.
- Adjustments can be made quickly and easily to maintain proper clearances between the impeller and casing, thus prolonging efficiency along with pump life.

An important feature available with this pump is overhead motor base mounting shown at right. With this arrangement, valuable floor space is conserved, and water and muck can't reach vital motor parts. *For details contact your nearby A-C office, or Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.*

The complete pumping unit . . . pump, motor and control . . . is offered by Allis-Chalmers.



Titanium ore application makes good use of overhead motor mounting on A-C rubber-lined pumps.

Plan to stay ahead... MODERNIZE!

ALLIS-CHALMERS

A-5980-MM

Has no springs, rides on Hydrair*

— With Haulpak's exclusive air-hydraulic suspension system, you completely eliminate maintenance and repair of springs. 4 Hydrair units cushion against loading and travel shocks . . . keep unit riding level over bumps and holes. LW Haulpak also has exclusive LW power-transfer differential — permits unit to haul over wet, muddy areas that bog down competitive trucks.

You'll haul more tons per hour at lower cost . . . with

LW Haulpak®

Low loading height — (only 10'1" on 32-ton size) and large top opening (14'5" x 11') makes it easy to load LW Haulpak *fast*, without spillage.

This revolutionary off-highway truck gives you highest output at lowest ownership and operating costs. You get these profit-making benefits because the all-new, fully-proven LeTourneau-Westinghouse Haulpak is built *specifically* for rugged, heavy-duty hauling. It is not a "beefed-up" highway truck . . . nor does Haulpak have the maintenance problems common on ordinary haulers.

Notice, for example, Haulpak's rugged "V"-shaped body. This exclusive LW design gives you *bonus* yardage within a short wheelbase . . . makes for easy loading . . . and provides a low center of gravity for exceptional stability.

LW Haulpak's short, 130-inch wheelbase gives you unusual maneuverability (makes non-stop U-turn in area only 44'6" wide . . . shortest turning radius of any big off-road truck). You spot, swing around, back up and dump *fast* . . . you eliminate most maneuvering delays, complete faster cycles. You have "feather-touch" power-steer, too . . . system is located high behind bumper, well protected from damage.

And, very important, time lost for maintaining your Haulpak is practically nil. It needs *no* daily lubrication. The entire Haulpak lubrication check — *needed only at 500-hr intervals* — consists of just 4 easily-reached grease fittings. In addition, LW Haulpak's various parts and assemblies — some of them tested and proved by *millions of hours* on LW Tournapulls® all over the world — are much stronger than those used on competitive haulers.

22, 27, 32-ton sizes

Ask us for detailed specifications on the size Haulpak that fits your needs. Available in 22, 27, and 32-ton sizes . . . 290, 335, and 375 hp. Compare its features with any other truck in the industry . . . you be the judge!

*Trademark HP-2155-G-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

PROFIT NEWS FOR POWER USERS IN THE

all purpose power line

(20 TO 1650 H.P. IN ONLY 3 CYLINDER SIZES)

Now you can enjoy all the benefits of GM Diesel standardization in every type of equipment and still buy the best makes of equipment on the market

GM Diesel engines are offered in more than 1800 applications of power equipment built by over 250 leading manufacturers—wider availability than any other Diesel.

Only by standardizing on GM Diesel will a user get *all* the benefits of engine standardization—for *only* GM Diesel covers the entire power range with only 3 cylinder sizes.

Widest parts interchangeability pays off for operators in lower parts inventory requirements—many parts for a 33 H.P. "Jimmy" Diesel fit a 1650 H.P. "Jimmy."

GM DIESEL

PARTS AND SERVICE WORLDWIDE

DETROIT DIESEL ENGINE DIVISION, GENERAL MOTORS, DETROIT 28, MICH.

In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario

Shrink distance...and OVERHEAD

with hustling, go-anywhere tractor

Are you still supporting *part*-time pit workers — 3 or 4 crawler tractors — for maintenance jobs? You're carrying unnecessary overhead if you do. Limited speed and mobility tie crawlers down to a limited working area. Lack of continuous work in those "pockets" often keeps them idle much of the day. Yet the cost of owning and maintaining a fleet of localized dozers is continuous.

It's possible that you may be able to replace those inefficient units with a single tractor... a mobile dozer-*on-rubber* that goes anywhere anytime you have work to be done. The 17-mph, 218-hp LeTourneau-Westinghouse C Tournatractor® is a "hit-and-run" specialist that handles pit housekeeping *just* as efficiently as a fleet of several special-purpose crawlers and can often cut clean-up and other dozing expense by half the present cost or more.

Travels at twice crawler rate

Tournatractor gives you the speed and mobility that pays off in servicing scattered locations. Travel to the next job is at speeds up to 17 mph — twice as fast as that of most crawler-mounted dozers.

Speed ranges, 4 forward, 2 reverse, are selected by simple hand lever. Within ranges, torque converter automatically adjusts power to load. Blade movement is accurately controlled electrically, through fingertip dashboard switches.

Check your multiple tractor operations for productive hours of operation. If travel and waiting time figures 30% or more be sure to ask for a Tournatractor demonstration.

Stripping dirt and clay overburden is just one of many jobs C Tournatractor takes in stride for Millbrook Quarries, Inc., Broad Run, Va. Handy "hit-and-run" dozer also cleans up pit after blasting, shapes limestone stockpiles, cleans around crusher, and tows equipment. Output averages 1,000 tons per day.

"If I could get a hold on it, I could move a mountain with this Tournatractor," says Operator Claude Wampler at Millbrook Quarries. "This dozer's got plenty of power and speed, doesn't take all day to get to a job. It's easy to throttle down from high travel-speed."

CT-2027-MQJ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

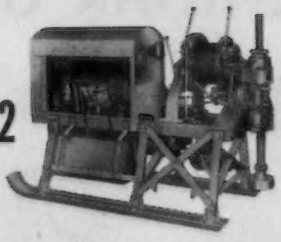
Where quality is a habit

BBS-1

World's best known surface drill. Handles "E" Rods to 1,500 ft., "A" to 1,100 ft.

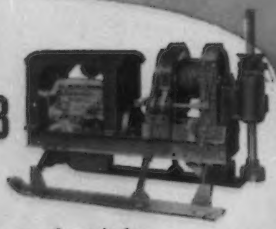
X-ray

Compact, portable—185 lbs. net. Takes ¾" or ⅜" core to 200 ft. Low fuel consumption.



BBS-2

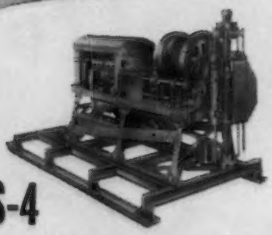
Versatile, choice of 5 swivelheads. Depths to 3,500 ft. Gas or diesel.



BBS-3

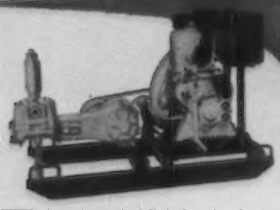
Strong, speedy unit for deep drilling . . . 4,600 ft. with "A" or "B" Rods, 95 h.p. diesel.

if it's for diamond drilling we make it!



BBS-4

Drills to 5,000 ft. with "B" Rods. Moves under own power, gas or diesel.



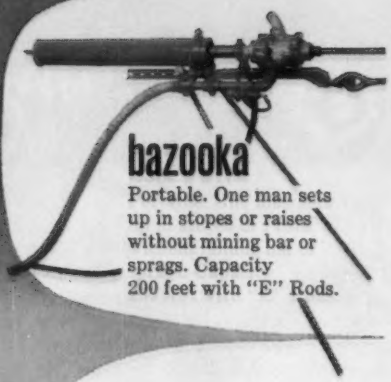
drill pumps

5-12 and 4-7 models. Capacities 400 to 1,200 g.p.h. Diesel motor optional.

permaset bits

(Powdered metal)

All standard sizes available from stock. Also reaming shells, etc.



bazooka

Portable. One man sets up in stopes or raises without mining bar or sprags. Capacity 200 feet with "E" Rods.

JV

4 feed swivelhead. Capacity 800 ft. with "E" Rods. JVR with right-hand feed screw for blastholes.

BBU-2

Rugged. Capacity 1,800 ft. with "E" Rods, 1,400 ft. with "A", four gear speeds.

VEG

Vane motored version of J.V. Lightweight, compact construction. Can be speedily dismantled into two units.

58-5

BOYLES BROS
DRILLING COMPANY LTD.
VANCOUVER, CANADA

BOYLES BROS. DRILLING CO. LTD., NEWCASTLE-ON-TYNE, ENGLAND • BOYLES BROS. (PTY.) LTD., JOHANNESBURG, SOUTH AFRICA
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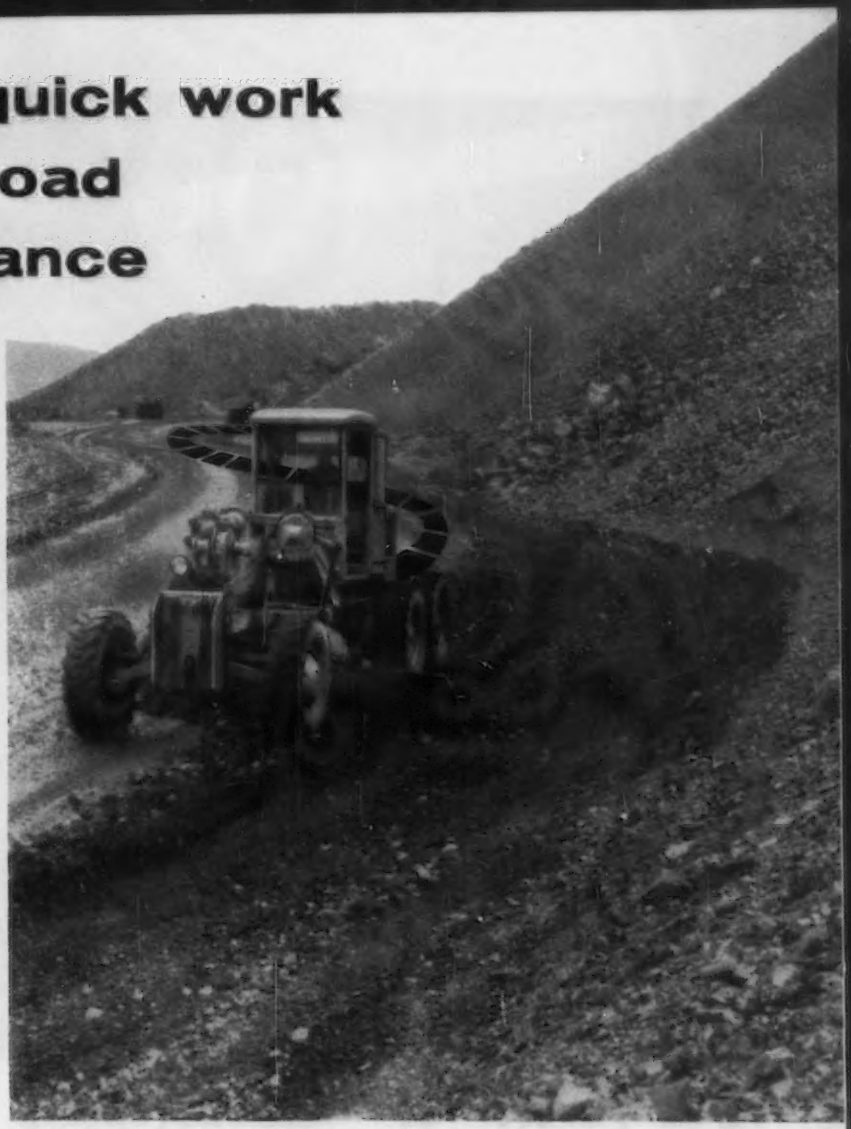
Makes quick work of haul-road maintenance



Powerful L-W Adams 660 — at large open-pit mine in Arizona — patrols busy haul roads 24 hr a day, 6 days a week. Grader goes wherever needed (at speeds to 26 mph) to fill ruts, level washboard, clear debris dropped by overloaded haulers and improve drainage.

You know from experience that using the *right* tool on any job completes the work faster and easier. The same holds true when maintaining your haul roads, pit floor, dump areas around crusher, and stockpiles, or waste dump. Use a heavy-duty L-W Adams† grader for these maintenance assignments. You'll find you can complete this work *faster* and *at lower cost.*

Greater work range

All LeTourneau-Westinghouse 80, 115, 123, and 160 hp Adams graders have constant-mesh transmission as standard, with 8 forward and 4 reverse speeds. In addition, 3 optional creeper speeds provide extra lugging power for turning up rocky subsurfaces and for greater grading accuracy. Choice of 15 gear ratios give you the balance of power and speed to handle every grading job . . . in any material . . . at top efficiency.

Smooth, accurate control

Adams' blade mechanism is firmly mounted on a heavy-duty circle for chatter-free operation. Strong T-shaped drawbar gives L-W grader firm circle support for accurate blading in any material.

Blade positioning is fast . . . it swings maximum arc from deep ditch-cut to high bank-cut in less than a minute. Moldboard turns 360° — clockwise or counter clockwise — provides quick change from any forward work position, to desired angle for reverse ditching and grading.

Low operating costs

All gears operate on anti-friction bearings — for less wear, easier operation. Automatic braking on transmission, when hydraulic brakes are applied to wheels, gives safer operation and less maintenance. And because L-W power-control clutches shift on ball bearings, you have easier, smoother, safer controls . . . assuring accuracy, speed, and performance with minimum upkeep.

Keeps busy all year

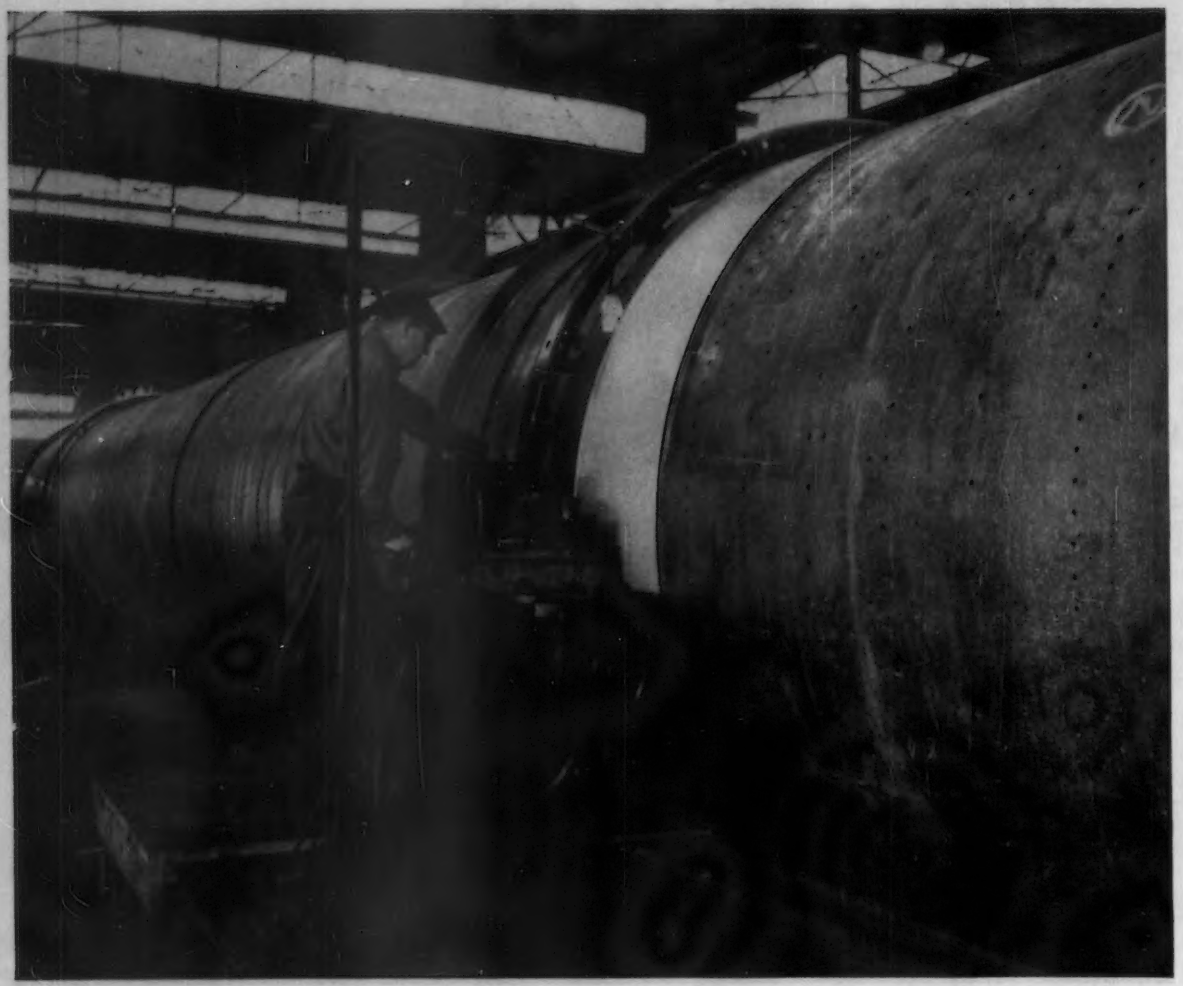
Between regular assignments, your LeTourneau-Westinghouse grader need not sit idle. With available attachments, such as Jebco Elegrader, bulldozer blade, scarifier, snow plow and wing, you can keep this grader busy on your property the year round. Also, grader's high travel speeds (to 26 mph) permit the profitable handling of jobs for adjoining pits. There are 7 Adams models — 67 to 190 hp. Your choice of GM or Cummins engines on 6 larger models. 190 and 145-hp POWER-*Flow*® models have torque-converter drive . . . will do more work faster than any other graders on the market. Call or write for a demonstration today!

†Trademark G-1874-MQ-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



Louisville Dryer—10 feet in diameter, 10 stories long!

Turn a ten story building on its side, and there'd be room to spare on either end of this huge pit lathe at Sharon, Pennsylvania where this 10′ x 110′ Louisville Dryer was fabricated.

This lathe is used for machining the reinforcing bands onto which are mounted the forged steel tires. This careful workmanship assures concentricity of the completed dryer shell—a primary factor in efficient seal operation.

Every Louisville Dryer is especially designed, manufactured, assembled and installed for its specific task.

If you have a problem involving process equipment, call or write our equipment specialist in your area. Here, as in so many fields, you'll find IT PAYS TO PLAN WITH GENERAL AMERICAN.

Process Equipment Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street, Chicago 3, Illinois
Offices in Principal Cities
In Canada: Canadian Locomotive Co., Ltd., Kingston, Ontario

Louisville Dryers

PROCESS EQUIPMENT DIVISION GENERAL AMERICAN TRADE MARK

EIMCO

design and production

PROGRESS REPORT

B 398

Filter Division of The Eimco Corporation, Box 300, Salt Lake City 10, Utah

EimcoBelt Filter Saves $200,000 First Year, in Recovery Operation!

In a classified chemical operation, gypsum was being recovered by thickening and countercurrent washing on two stages of vacuum filtration.

With standard drum filters, filtration of gypsum was troublesome. Excessive blinding of cloth filter media resulted in hundreds of pounds of valuable product being lost every day.

When an EimcoBelt filter replaced the standard drum for the first filtration stage in this operation, it immediately overcame all filtering difficulties — because of its' ability to maintain a continuously clean medium.

The EimcoBelt, with its' unique new operating principle, removes the filter medium from the drum every cycle . . . discharges the cake over a small diameter discharge roller . . . washes the medium with jet sprays . . . always returns a clean medium to the drum.

Soluble losses were reduced to less than one-third the average losses with the two conventional drum filters — resulting in savings of over $200,000 a year for this company!

Moreover, it soon became apparent that the new filter could handle the filtration load formerly handled by the two drum filters. Accordingly, the second stage drum filter was eliminated from the flowsheet.

6-ft. diameter by 6-ft. face EimcoBelt filter installed for gypsum recovery.

SEND FOR
EIMCOBELT
Bulletin F-2053

Write the Eimco Corporation, Box 300, Salt Lake City 10, Utah, for your copy

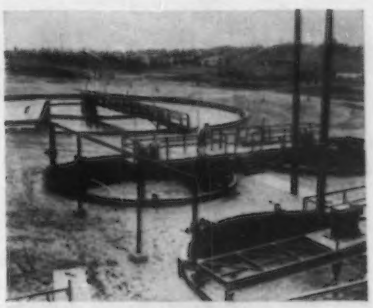
Eimco-Process Equipment Selected for Acid Neutralization and Scrubber Effluent Clarification at Aluminum Plant

Need for a positive system to neutralize and clarify a fluorine-bearing effluent prompted the operators of an aluminum reduction process to contact Eimco-Process Engineers. Close work with the company engineers in a test program led to the development of an ingenious flowsheet and custom-adaptation of Eimco-Process equipment to the system requirements.

Careful planning, designing and fabricating, plus conscientious field services, has resulted in a dependable, economical system that gives its user maximum returns from every invested dollar.

In treating the hydrofluoric acid waste, effluent from scrubbing towers passes through three stages of neutralization in Eimco-Process Contactors, followed by clarification in a Type CM Eimco-Process Reactor-Clarifier. The clarifier overflow has a turbidity of 10 ppm or less and is returned to the scrubber water system for re-use.

Other Eimco-Process equipment in this treatment plant includes lime feeders, lime slakers and coagulant mixers and feeders.



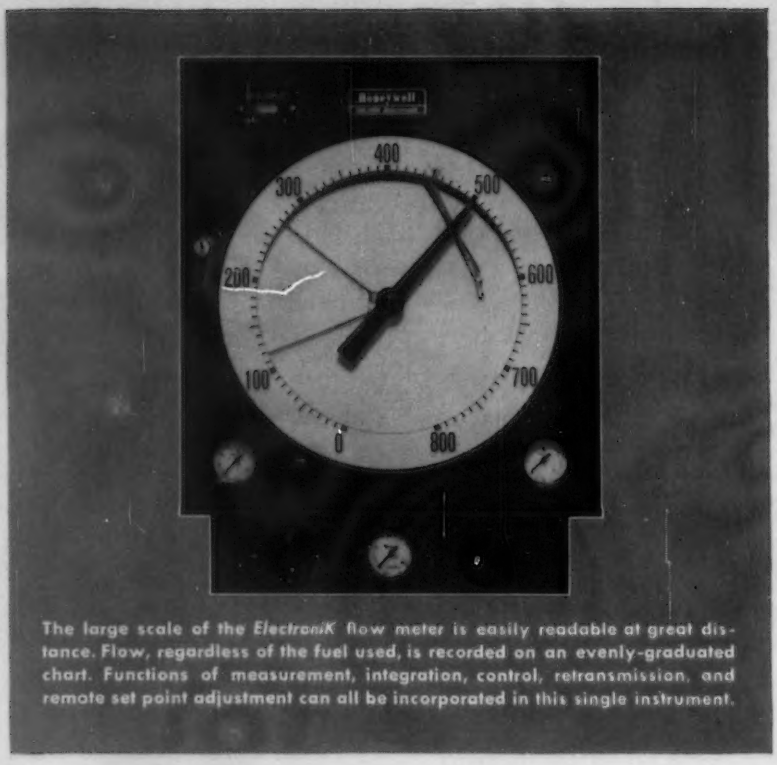
Aluminum processor gets high separation efficiency with this Eimco-Process Reactor-Clarifier.

Process Engineers Division
THE EIMCO CORPORATION
420 Peninsular Ave., San Mateo, Calif.

use these accessories with the *ElectroniK* flow meter

Area type electric flow transmitter for measurement of the flow of oil, tar, pitch or other viscous fluids.

Ledoux bell type electric meter body for measuring atomizing steam flow.



The large scale of the *ElectroniK* flow meter is easily readable at great distance. Flow, regardless of the fuel used, is recorded on an evenly-graduated chart. Functions of measurement, integration, control, retransmission, and remote set point adjustment can all be incorporated in this single instrument.

ElectroniK

flow meter lets you switch fuels without upsetting fuel-air ratio

. . . records, indicates, integrates, controls and transmits

Bell type electric meter body for measurement of air or gas flow.

Honeywell diaphragm control valves for fuel, air and steam flows.

Use the highly versatile, accurate *ElectroniK* flow meter to save fuel dollars and improve operating efficiency in combined fuel systems. It's calibrated for both gas flow and equivalent oil flow, and automatically proportions the input of each type of fuel on the basis of total Btu input required at the furnace.

The *ElectroniK* flow meter operates on the induction bridge principle, for highest accuracy. For freedom from vibration effects, pen and pointer are positioned by the dependable Brown balancing motor and amplifier used in all *ElectroniK* instruments.

The meter can be supplied with an adjustable *Indexet* unit by which the set point can be established from a remote point—manually, by a pneumatic loading station, or automatically, by another instrument. *Indexet* also provides the wide span and zero adjustments needed to "tune" the instrument to the process with extreme precision.

Other options, such as a re-transmitting slidewire or pneumatic transmission unit, adapt the *ElectroniK* flow meter to a variety of interlocked systems. The flow transmission system permits remote location of the meter.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

H HONEYWELL *First in Control*

Entrance to Mont Blanc tunnel from the Italian side where Impresa Condotte d'Acqua has bored more than 500 meters of tunnel using Eimco equipment.

Eimco tractor-excavator near the Mont Blanc tunnel site and the Eimco-Italia service van.

Ever since Hannibal made his historic crossing of the Alps, men have dreamed about tunneling a roadway through Europe's highest peak, 15,781 foot Mont Blanc. This tunnel now is becoming a reality with Eimco 105 Tractor Excavators being used for mucking. This will be the world's longest (7.5 miles) vehicular tube and will link France and Italy with an all-weather highway when completed in 1961.

Tunnel crews working from both the French and Italian sides are using Eimco equipment — because Eimcos have a reputation around the world of doing rock and earth moving tasks efficiently, safely and F-A-S-T!

FLEXIBLE POWER FOR TUNNEL WORK — The Big E lifts large chunky boulders, over 10 tons, without need for breakup . . . Cushioned torque converter, unidrive power, with up to 39,000 pounds of breakout force, automatically matches the gear to the load!

EASE OF OPERATION — In restricted areas like a tunnel, the Eimco Excavator really stands out. No turning to discharge load. Fastest possible loading cycle. Minimum operator fatigue because there is no more tugging at levers nor pushing on foot pedals. Operators get instant response from finger-tip controls.

LOW MAINTENANCE — Superior, quality controlled construction from the pouring of metal to finished product . . . sealed anti-friction bearings, extra heavy heat treated steel pins and bushings . . . Simplicity of Unidrive transmission . . . No master clutch to wear out or service . . . Just a few of the reasons why Eimco machinery is on the job day after day, hour after hour.

For more information about why EIMCO is the machine for your specific operations, contact an EIMCO sales-engineer at the sales office nearest you, or write to The Eimco Corporation, P.O. Box 300, Salt Lake City 10, Utah

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B - 472

CHECK THIS GARDNER-DENVER LINE-UP BEFORE YOU BUILD OR BUY YOUR NEXT JUMBO

1 REMOTE CONTROLS . . . all controls, both hydraulic and pneumatic, can be arranged for handling all operations from a centralized location —the most convenient location for your drilling operation.

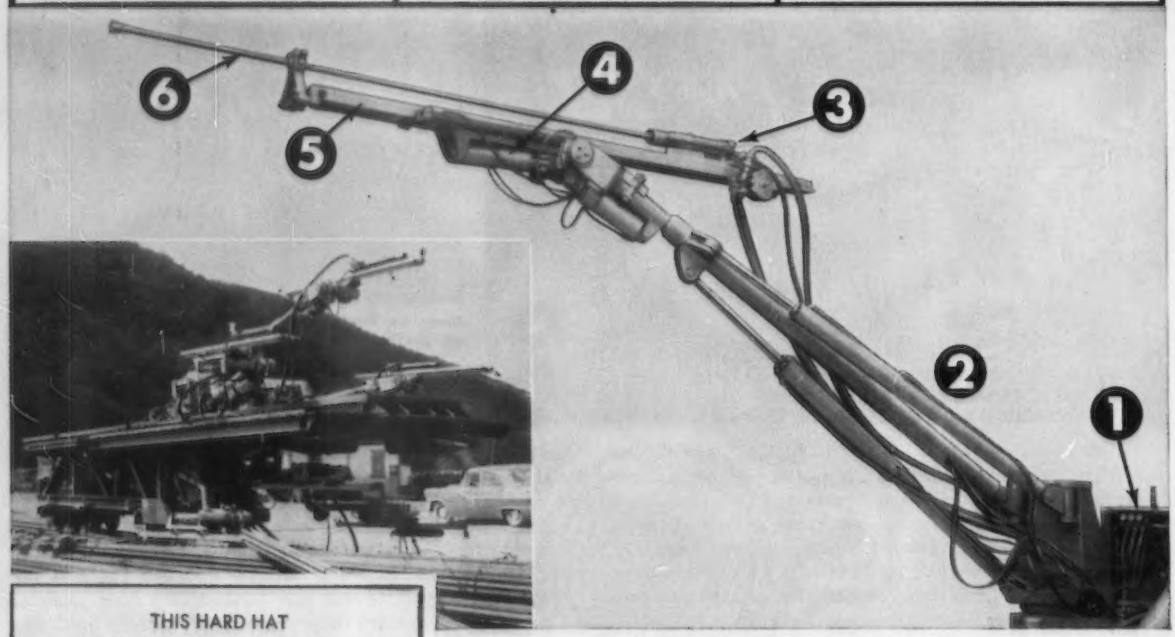
2 BOOMS . . . hydraulic, creep-free booms—straight, offset or tripod types. A choice of hand or automatic hydraulic pump. Lengths to suit your drilling needs.

3 DRIFTERS . . . seven hard-hitting, fast-acting models—the most complete line of time-tested drifter drills available. Sizes from 2¾" to 5½" cylinder bore.

4 DRILL POSITIONER . . . DPU hydraulic drill positioner—120° swing (60° from center to center), 90° dump (30° up, 60° down)—can be indexed for roof pinning or down hole drilling.

5 FEEDS . . . aluminum alloy screw feeds take steel changes up to 12′. New channel screw feed mountings permit changes up to 14′. Lightweight and heavy-duty chain feeds for changes to 20′. All can be remote-controlled.

6 DRILL STEEL . . . most complete line of sectional carburized drill steel (five series from ⅞" hex. to 1⅞" hex.) in lengths from 2′ to 20′. Carburized to resist abrasion longer and increase compressive strength. Also carburized made-up steel in a variety of sizes, shanks and lengths.



THIS HARD HAT
MEANS BETTER DRILLING

Gardner-Denver men and mining engineers have worked hand in hand for many years. This teamwork has resulted in a safe, hard-hitting line of drilling equipment for use in every type of rock and ore. At Gardner-Denver there's no substitute for men —our philosophy of growth for 100 years.

Here's the most complete and versatile line of coordinated drills, feeds, booms and controls available anywhere. Save time and manpower. Drill faster. Hold line cuts in line. Or use big bore burn cut for pulling deeper rounds. Handle high-face room and pillar mining with ease. See your Gardner-Denver jumbo specialist. He can help you plan a job-built, custom-engineered jumbo using your own truck or tractor . . . or deliver a complete Gardner-Denver crawler-, wheel- or rail-mounted jumbo.

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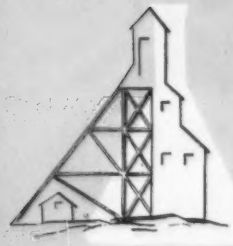
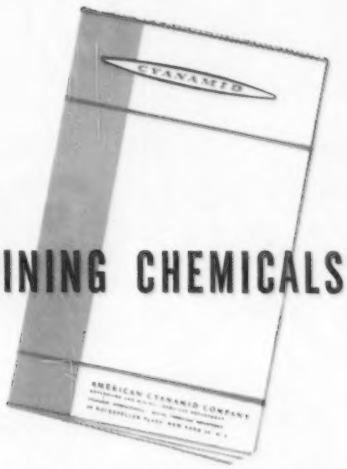
CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"



to help you
in re-evaluating
your reagent combinations:



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- *2 new Anti-Precipitants*
- *2 Carbon Control Agents for Cyanidation*
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Maximum strength with minimum weight...

Unmatched holding power on the shaft...

New mounting simplicity.

The rims, discs and hubs of these modern conveyor pulleys are *steel*—and they are fused together into jointless drum construction for (1) maximum strength with minimum weight, (2) exclusion of dirt, water, steam, (3) terrific shock resistance.

With the patented Dodge Back-up Bar, welds of full rim thickness are achieved—and the ultimate in strength is assured by submerged arc process welds.

Taper-Lock Steel Conveyor Pulleys *hold*. Taper-Lock provides the equivalent of a shrunk-on fit—there is no "walking" on the shaft. Mounting and demounting are simple. Pulley and bushings mount as a unit. Alignment is easy. And the tapered bushing is wedged into place merely by turning the mounting screws. It is "unlocked" by using the mounting screws as jack screws.

Available in diameters from 6 inches to 8 feet—all face widths. Standard or special rubber lagging available. Ask your local Dodge Distributor—or write us for bulletin.

DODGE MANUFACTURING CORPORATION, 3100 Union, Mishawaka, Ind.

97 Taper-Lock Steel Conveyor Pulleys are used in this famous conveyor system engineered, manufactured and erected by Hewitt-Robins, Inc., at the Southern Pacific's causeway construction across the Great Salt Lake.

DODGE

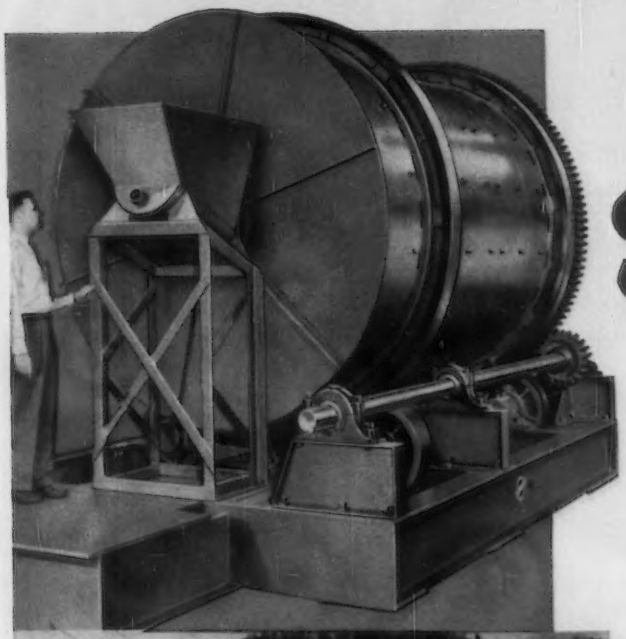
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

FOR CLEAN ORE—HIGH CAPACITY

TELSMITH

Super-Scrubbers®



● **high speed...terrific impact...grinding action much like a ball mill.** Ore travels from feed to discharge end against clean water flowing in the opposite direction —emerges clean—with clay and dirt disintegrated and carried away by the water.

low cost installation, operation and up-keep. Economical of water and power. The Telsmith Super-Scrubber is made in four sizes: 60-inch to 96-inch; with capacities of 50 to 250 tons per hour. Send for descriptive Bulletin 266.

Philippine Islands—this mill of **Baguio Gold Mining Company** is equipped with a 60-inch Telsmith Super Scrubber.

●

Minnesota—in the custom mill of **Skubic Bros.**, Virginia, Minn., a 96-inch Telsmith Super Scrubber turns out remarkably clean ore at minimum cost.

Min. 38

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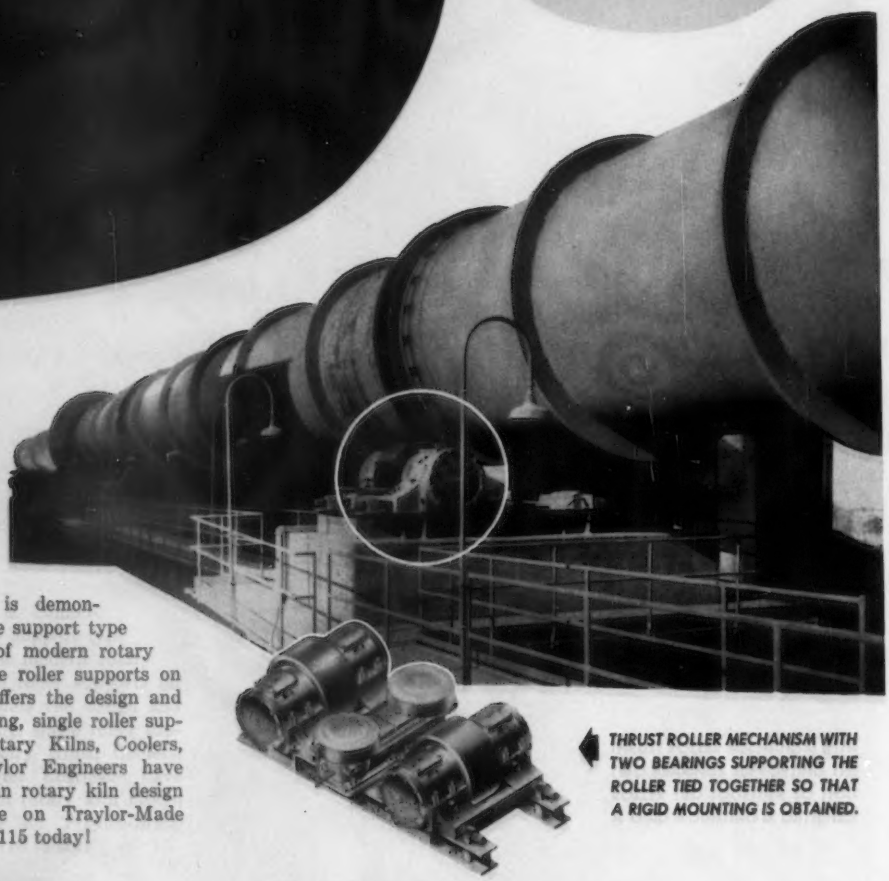
sign of engineering leadership

Traylor



ROTARY KILNS

Leadership in engineering is demonstrated by the Traylor single support type roller bearings. Efficiency of modern rotary kilns depends largely on the roller supports on which they run. Traylor offers the design and perfection of the easy aligning, single roller supports, used on Traylor Rotary Kilns, Coolers, Dryers and Slakers. Traylor Engineers have over fifty years experience in rotary kiln design and manufacture—for more on Traylor-Made kilns write for bulletin No. 1115 today!

THRUST ROLLER MECHANISM WITH TWO BEARINGS SUPPORTING THE ROLLER TIED TOGETHER SO THAT A RIGID MOUNTING IS OBTAINED.

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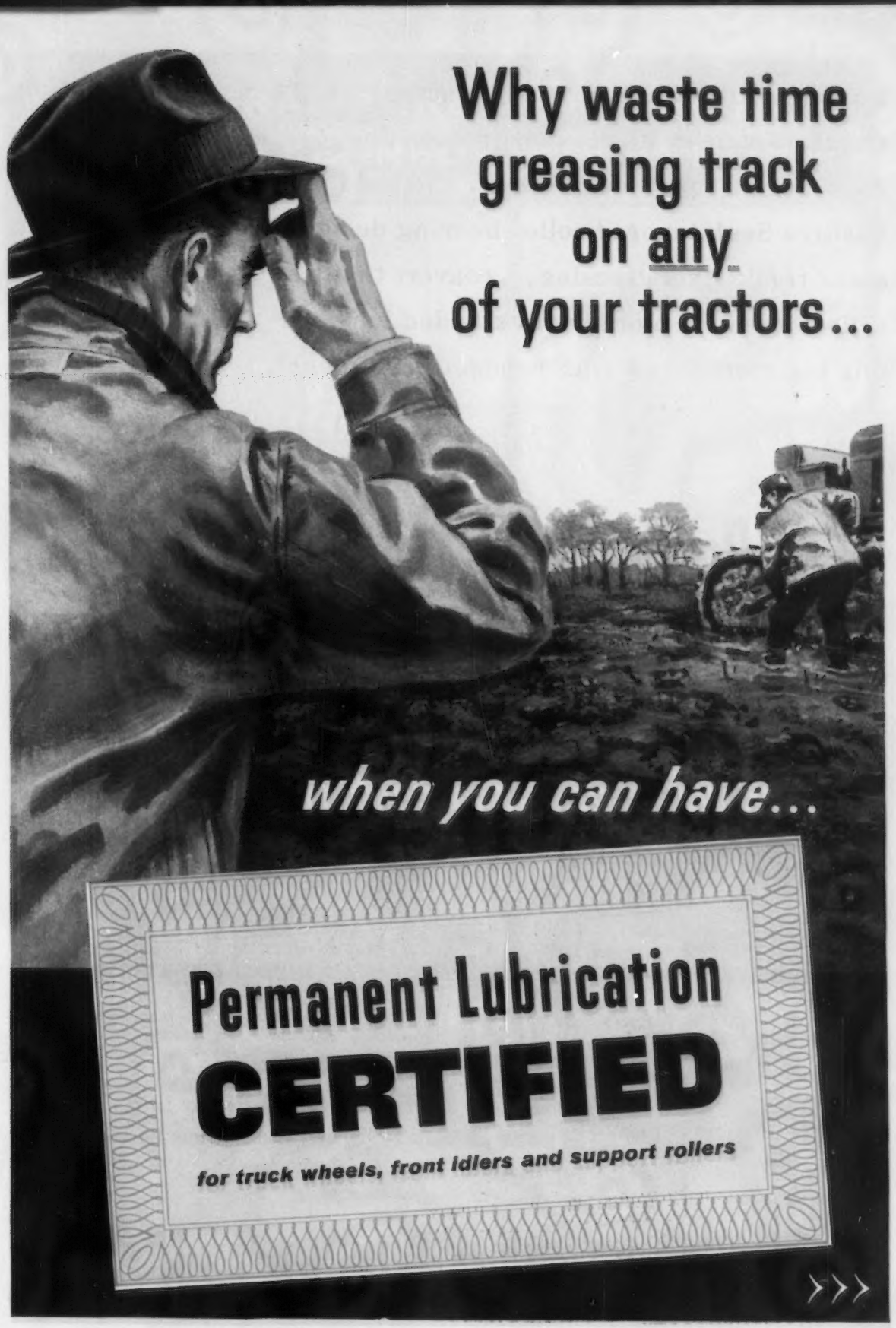
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CERTIFIED
for truck wheels, front idlers and support rollers

Now . . . Allis-Chalmers announces PERMA-SAFE lubrication for all models in its crawler tractor line . . . climaxing more than 20 years of constant research and on-the-job experience with Positive Seal, tapered roller bearing design. Now you can forget about track-level greasing . . . convert that lost time to profit time. Allis-Chalmers, pioneer of extended lube intervals, lets you take this big step ahead with complete confidence.

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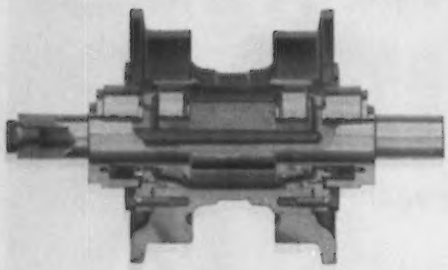
The Positive Seal AC PERMA-SAFE Wheel

for truck wheels, front idlers and support rollers on all models of Allis-Chalmers crawler tractors



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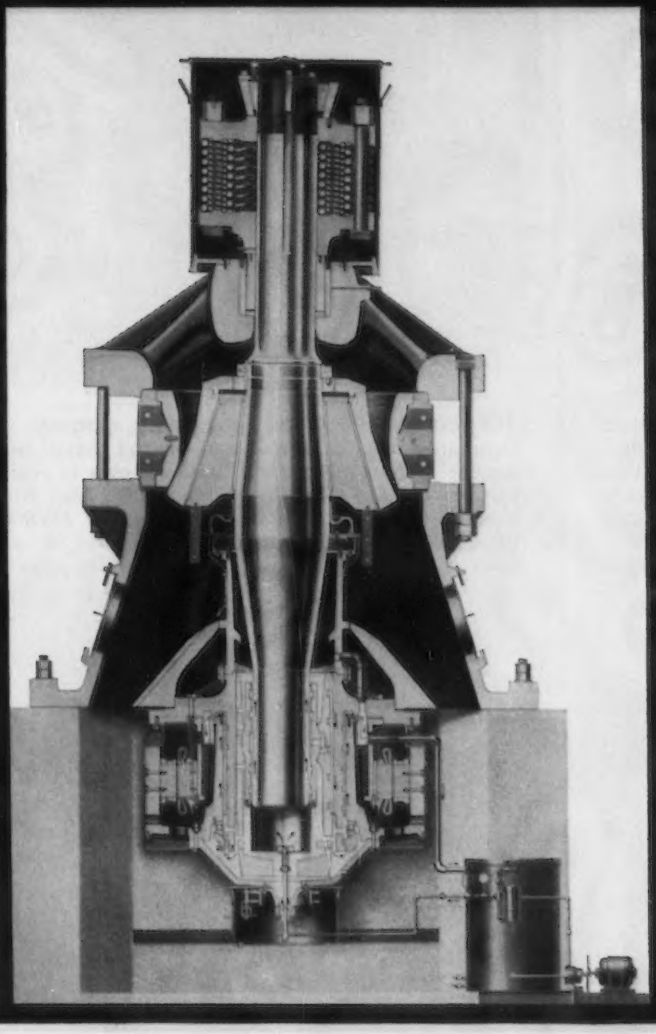
2-WAY TRAMP IRON PROTECTION

Exclusive with the KENNEDY Gearless Reduction Crusher



Ordinary tramp iron and uncrushable oversize is passed by the quick-acting, positive spring cage, without damage.

The KENNEDY patented built-in drive coupling with its overload device, provides positive protection against breakage from unusually large pieces of tramp iron. Operates only when uncrushable material enters crusher.

Uncrushable material inevitably finds its way into every reduction crusher. Only with the KENNEDY Gearless Reduction Crusher is absolute protection assured—for only KENNEDY provides 2-way protection against costly machine damage.

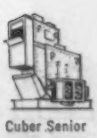
Write today for your copy of Bulletin No. 58-D describing the many other important features of the KENNEDY *Gearless Reduction Crusher.*

KENNEDY VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N.Y. • FACTORY: DANVILLE, PA.

Primary Gyratory



Cuber Senior

Cuber Junior

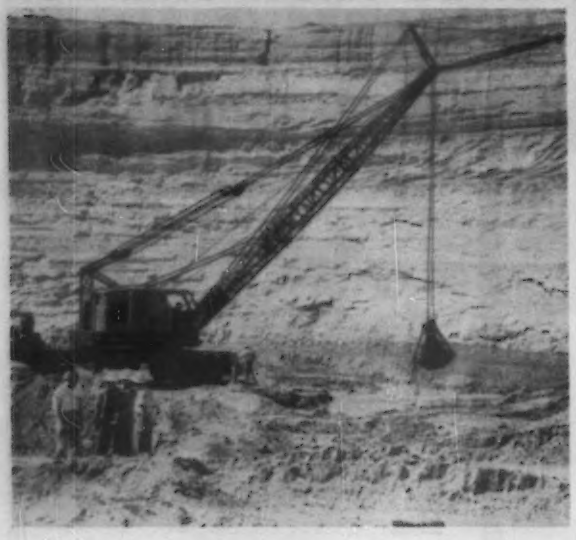
Hammer Mill

Roll Crusher

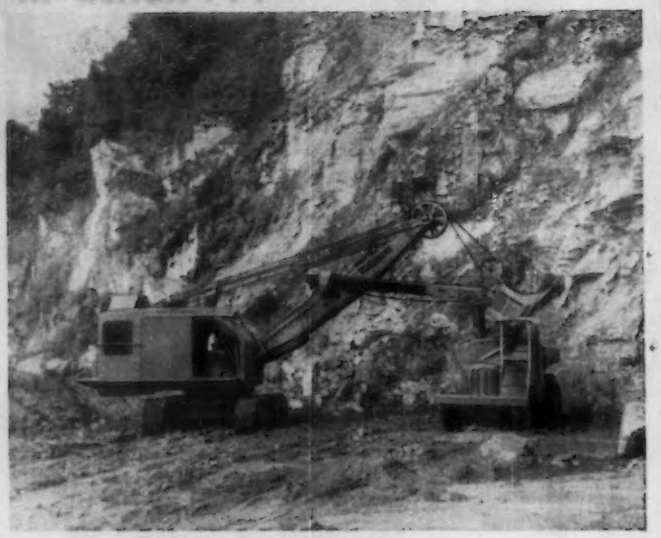
Overhead Crusher

Swing Jaw Crusher

KOEHRING WORK CAPACITY *in action . . .*



De-watering a pit — At a western uranium mine, Koehring® 545 truck crane with clamshell digs a central drainage sump, from which water will be pumped out of the deep pit. Biggest truck crane in the Koehring line, this 545 is a heavy-duty workhorse on wheels! Lifts up to 45 tons. Boom lengths: 40 to 120 ft. — maximum 150-ft. boom-and-jib.



10-year veteran at limestone quarry — Originally, this Koehring 605 helped build the cement plant at this quarry. That was over 10 years ago. Since then, the 1½-yard has been used full time loading out limestone rock — about 225,000 tons per year. Rock is hauled from quarry to the plant by Koehring fast-shuttling 6-yard Dumptors.

High-lift stripper — With 2½-yard dipper on *50-foot* boom, high-lift 1205 shovel put stripping on a long-reach basis at this mine. At 45° boom angle, it cuts up to 51 feet-4 inches — dumps at height of 40 feet-10 inches. It's also available with *3-yard* dipper on 40-foot high-lift boom — or as a *standard* 3-yard with 30-foot shovel boom.

A new kind of loader — the full-revolving Koehring 205 SKOOPER digs, swings, dumps, then swings back to digging position *without traveling.* Twin hydraulic rams crowd 2-yard bucket along 7-foot level cut *(from "stand-still" position)* — or dig at any angle of bank slope. There are 3 interchangeable buckets. Excavator-crane convertibility.

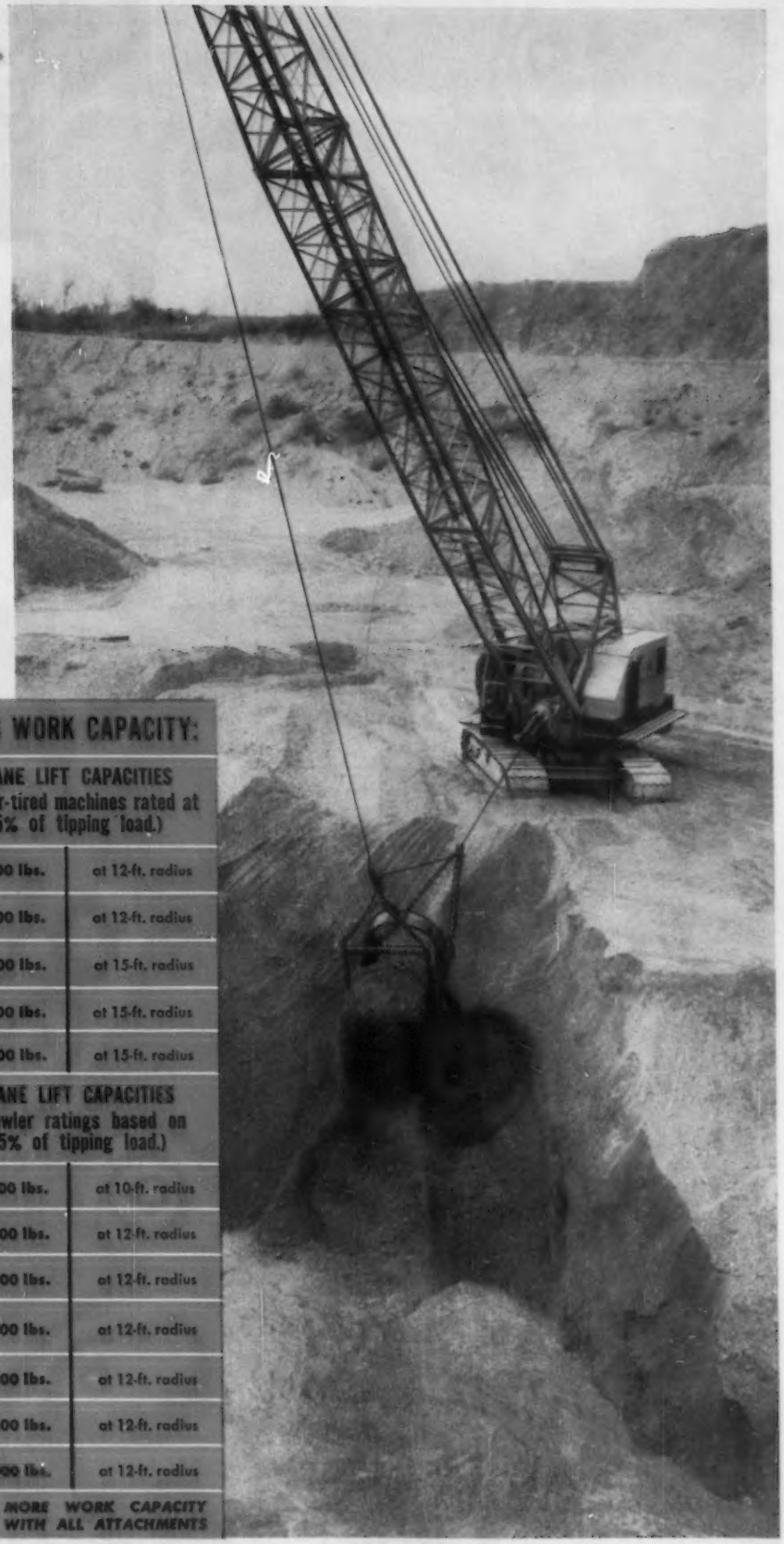
K934

KOEHRING DIVISION OF KOEHRING CO., Milwaukee 16, Wis.
Koehring excavators, cranes also manufactured in ENGLAND • SPAIN • JAPAN

In Canada:
KOEHRING-WATEROUS LTD.
Brantford, Ontario

Dredging gravel —

Working along the banks of a deep, water-filled pit, high-production dragline heaps a full bucket with every pass. It's the Koehring 805 — a special size that fills an important production gap on many mine and quarry operations. Depending on weight of materials, 805 handles 2 to 3-yard dragline bucket on 50 to 150-foot boom. Converts to clamshell, 52-ton lift crane, or 2-yard shovel. For all its size and capacity, the 805 is easy on the operator — 90% power-assist on main-drum clutches gives accurate "feel" of load, light lever-pull — helps increase output with all attachments. Want complete facts? Koehring distributor has all the details on this and other sizes (listed below). Call him today.

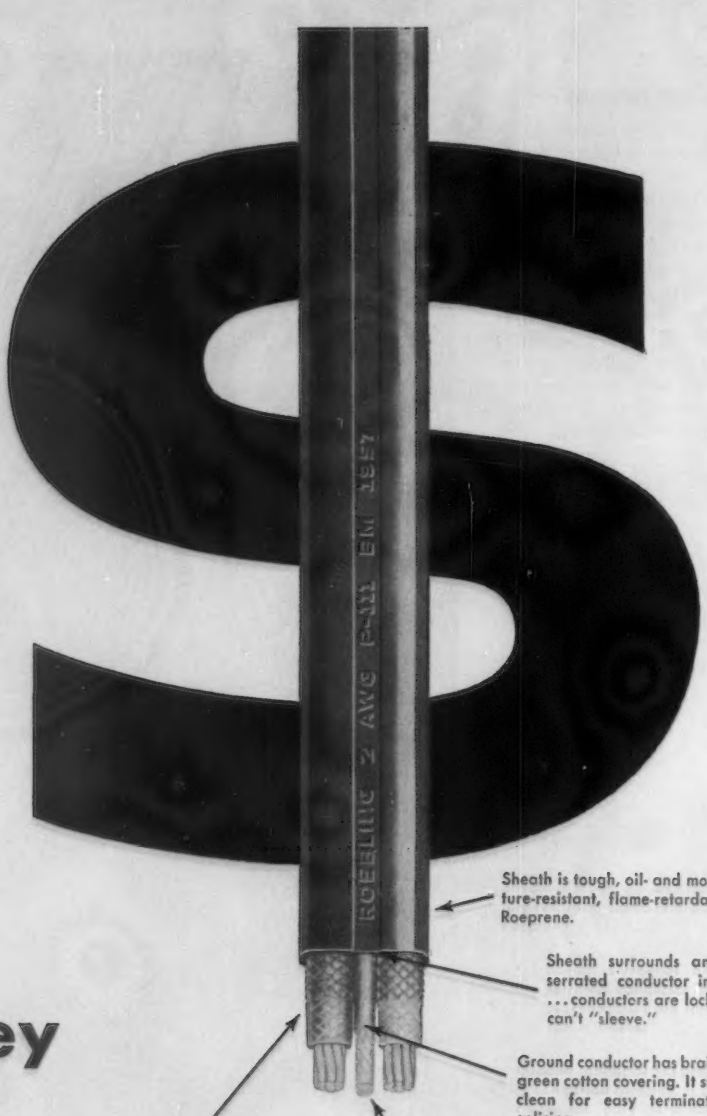


Quick facts on KOEHRING WORK CAPACITY:

MODEL	TYPE OF MOUNTING	CRANE LIFT CAPACITIES (Rubber-tired machines rated at 85% of tipping load.)	
ON RUBBER			
205	3-axle truck, or 21.5 mph Cruiser	30,000 lbs.	at 12-ft. radius
305	3-axle truck, or 18 mph Cruiser	50,000 lbs.	at 12-ft. radius
330	3-axle truck	60,000 lbs.	at 15-ft. radius
435	4-axle truck	70,000 lbs.	at 15-ft. radius
545	4-axle truck	90,000 lbs.	at 15-ft. radius
ON CRAWLERS	Size shovel	CRANE LIFT CAPACITIES (Crawler ratings based on 75% of tipping load.)	
205	½ Cu. Yd.	20,000 lbs.	at 10-ft. radius
305	¾ Cu. Yd.	30,000 lbs.	at 12-ft. radius
405	1 Cu. Yd.	40,000 lbs.	at 12-ft. radius
545	(Crane only — 85% rating)	90,000 lbs.	at 12-ft. radius
605	1½ Cu. Yds.	72,300 lbs.	at 12-ft. radius
805	2 Cu. Yds.	104,200 lbs.	at 12-ft. radius
1305	3 Cu. Yds.	190,000 lbs.	at 12-ft. radius

Extra lift capacity means . . . **MORE WORK CAPACITY WITH ALL ATTACHMENTS**

For the **extra life** that's **money in your pocket...**


ROEBLING 2 AWG E-111 EM 1557
Sheath is tough, oil- and moisture-resistant, flame-retardant Roeprene.
Sheath surrounds and grips serrated conductor insulation ...conductors are locked fast, can't "sleeve."
Ground conductor has braided green cotton covering. It strips clean for easy terminating, splicing.
GR-S insulation around each power conductor is heat- and moisture-resistant.
Ground conductor is braided and eased into shape from fine annealed copper wire for outstanding resistance to flexing fatigue and tensile stress.

ROEBLING PARALLEL TWIN CABLE!

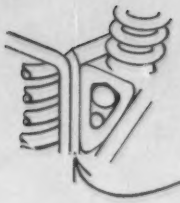
This economical, extra-flexible cable is available as Type G, with ground wire, or Type W, without. Complies with the flame resistance test of the State of Pennsylvania, Department of Mines, and the requirements of the U. S. Bureau of Mines, and carries the marking P-111BM.

A combination of quality features makes Roeprene® Parallel Twin Mining Machine Cable different and better. Some of these features may seem like small details . . . but, taken together, they figure *big* in terms of easier installation and maintenance, and valuable *extra* service life. Flexible Roeprene Parallel Twin Cable is built to take tough treatment!

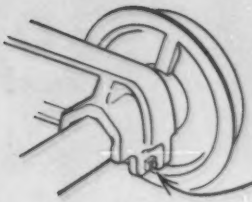
For more details about these cables, and the savings they mean, write Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

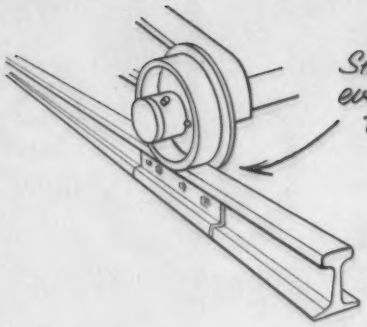
Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation



Movement between bolster and side frame is taken on specially designed wear surfaces

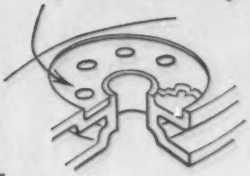


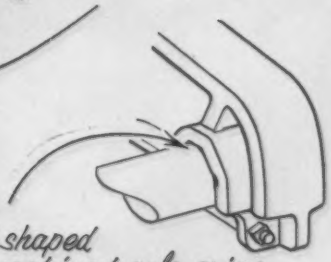
Quick wheel change



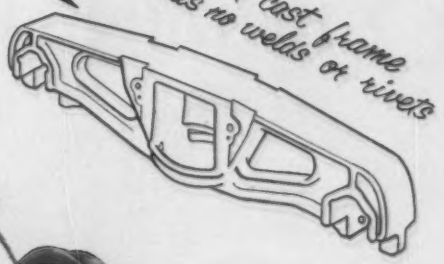
Smoother ride even on rough tracks

Large center bearing for longer life





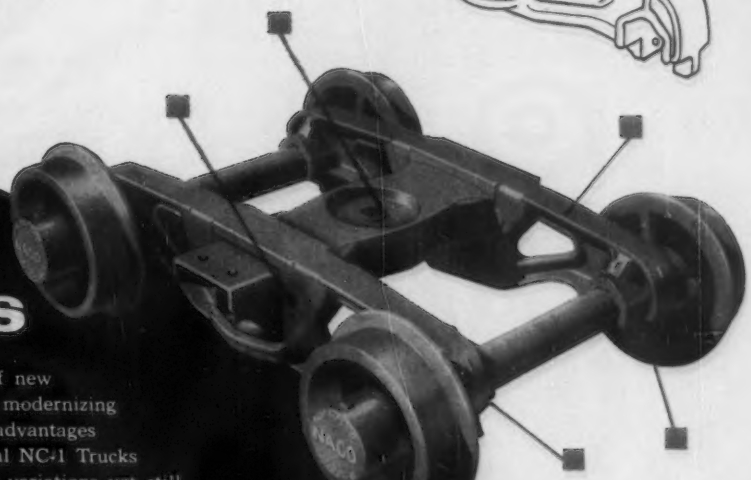
V-shaped machined axle grips for controlled flexibility and truck alignment



Integral cast frame has no welds or rivets

Check these "plus" features

OF NATIONAL NC-1 TRUCKS



If you're considering the purchase of new 8-wheel mine cars . . . or if you're thinking of modernizing older cars—*now* is the time to check the advantages of National NC-1 Trucks. National NC-1 Trucks have controlled flexibility for track variations yet still maintain truck alignment through their machined V-shaped axle grips. In addition, NC-1 Trucks have a built-in shock absorbing mechanism.

You get more out of your mine car investment per workshift . . . per day . . . per year. And at the same time you minimize spillage . . . get greater protection for your equipment, track and structures . . . slash maintenance to a new low.

Yes, *now* is the time to check National NC-1 Trucks—they make sense for 8-wheel mine cars . . . *make dollars for operators*, too.

- WILLISON AUTOMATIC COUPLERS
- RUBBER CUSHIONED UNITS
- NC-1 CAR TRUCKS • NACO STEEL WHEELS
- NACO STEEL LINKS & SWIVEL HITCHINGS

AA-5077

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY

Established 1868 *Cleveland 6, Ohio*

from URANIUM in SASKATCHEWAN
to NITRATES in CHILE . . .

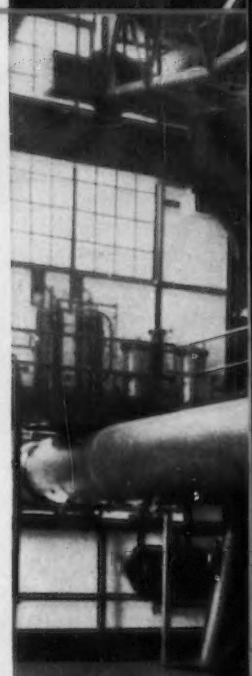
NORDBERG ENGINES
prove their reliability and economy
in MINING SERVICE

AT GUNNAR MINES, LIMITED . . . Neither bitter cold, nor inaccessible location could stop the successful development of a strategically valuable uranium ore deposit by Gunnar Mines, Limited, located in northwest Saskatchewan, less than 450 miles south of the Arctic Circle.

To meet the electrical power requirements for the construction and operation of mine, mill and town facilities, Gunnar chose seven Nordberg Supairthermal® 4-cycle diesel engine-generator units, each rated 1200 hp at 450 rpm, direct connected to 845 kw generators. Adding to the efficiency of this installation are waste heat boilers which utilize exhaust gas from the Nordberg engines to produce steam for heating plant buildings.

AT ANGLO-LAUTARO NITRATE CORPORATION . . . The story of power plant expansion for Anglo-Lautaro Nitrate Corporation's vast operations in northern Chile is largely a story of reliable Nordberg power. Their original Nordberg engine was a 7100 hp diesel unit installed in the Pedro de Valdivia plant, followed by the installation of two 1900 hp Nordberg diesels for the plant at María Elena. Then, to meet much needed additional power, two big 9600 hp Nordberg diesels were installed in a new power plant at Coya Sur.

Now Anglo-Lautaro has again turned to Nordberg to meet further power expansion, and has ordered *five more* Nordberg diesels, each rated 5750 hp, to be installed in the Pedro de Valdivia power plant. When these new engines are put in service, the combined generating capacity of all ten Nordberg engines will provide over 38,000 kilowatts for nitrate production.



While these installations in Saskatchewan and Chile are widely separated geographically, they serve as striking examples of the way in which Nordberg engines are serving the varied power requirements of the mining industry . . . especially in remote areas where dependable operation is of prime importance.

NORDBERG MANUFACTURING COMPANY
Milwaukee 1, Wisconsin

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P959

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK
ST. LOUIS • SAN FRANCISCO • TAMPA • WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

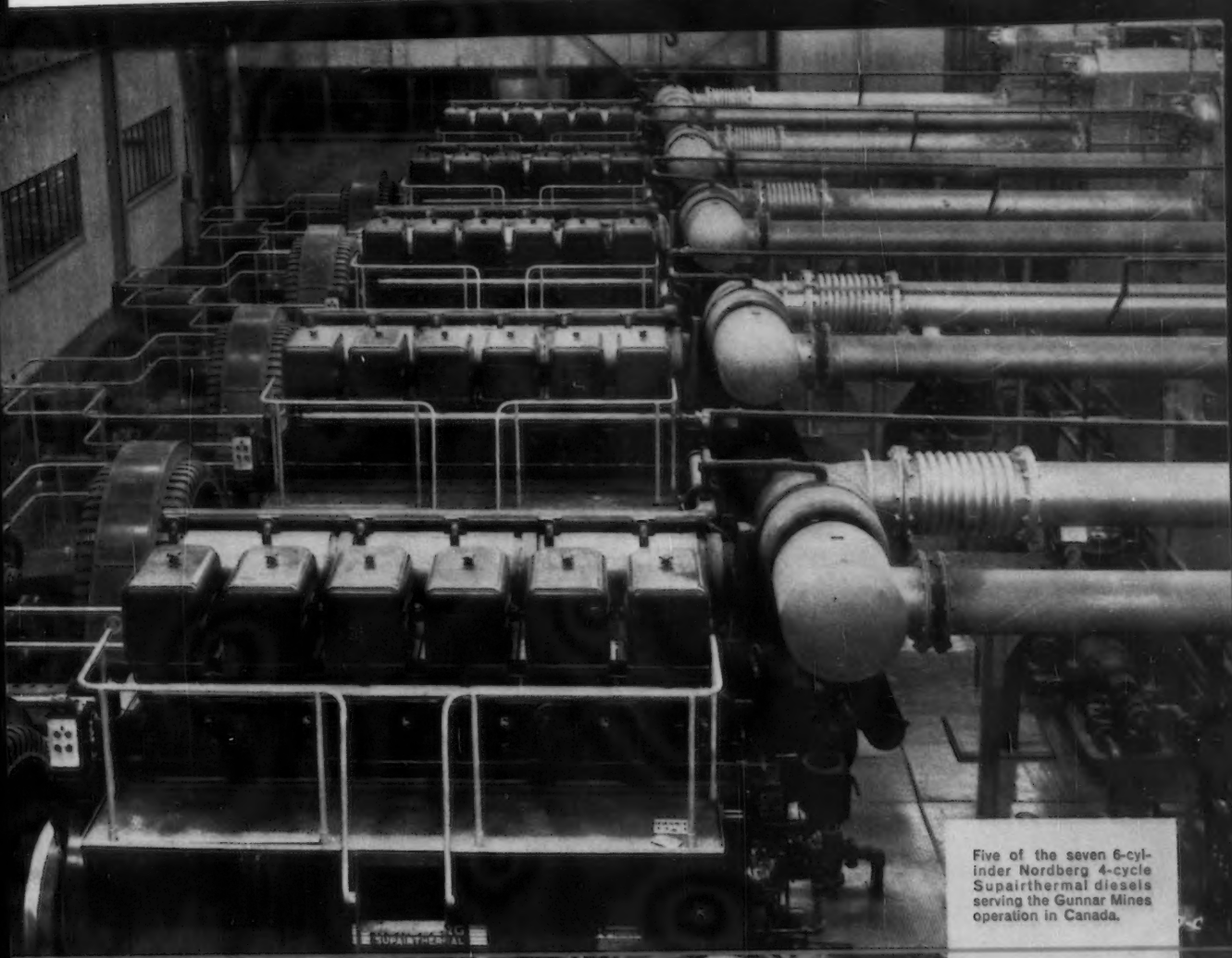
SYMONS® CONE CRUSHERS

NORDBERG GRINDING MILLS

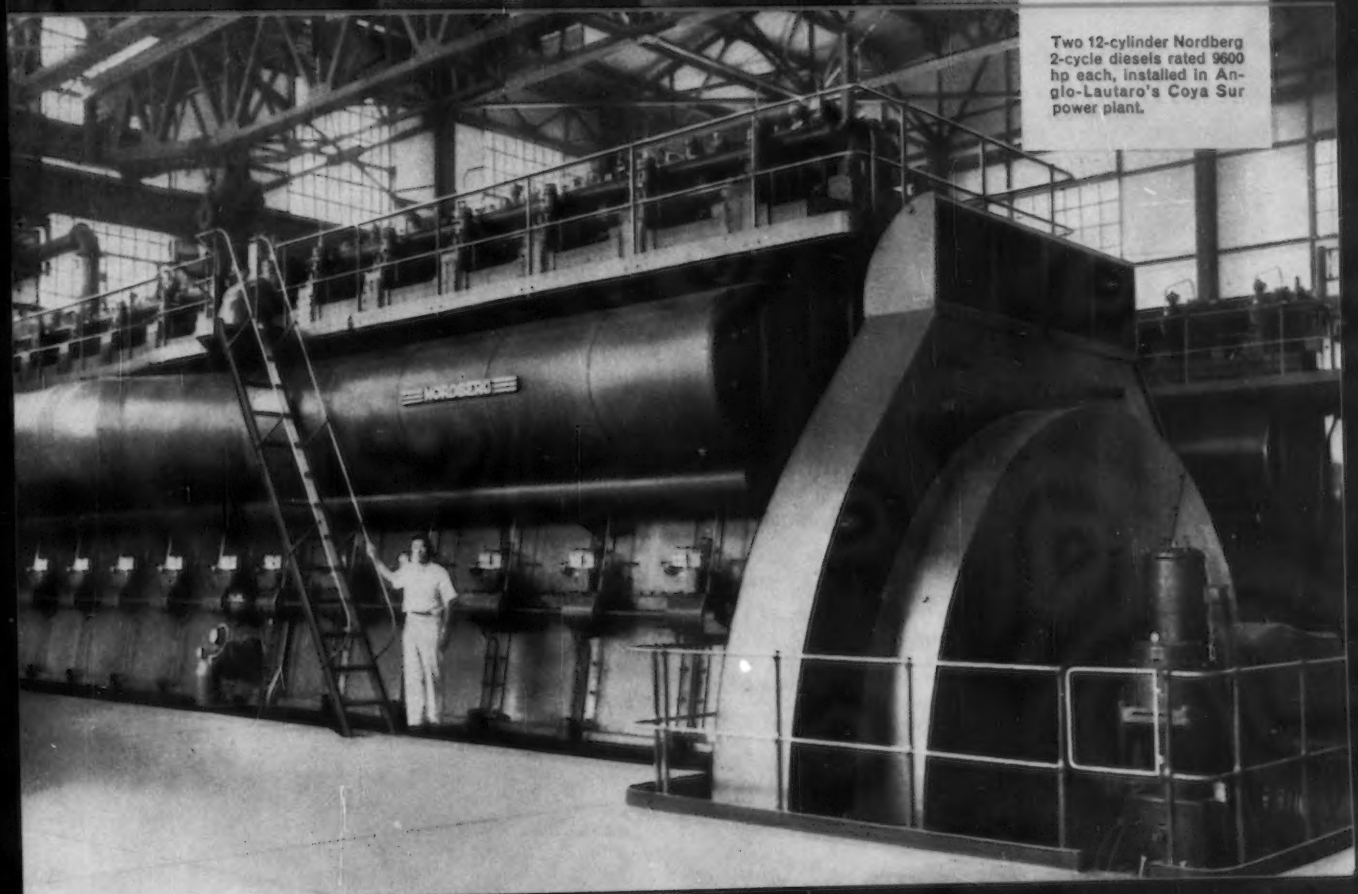
SYMONS VIBRATING SCREENS

SYMONS VIBRATING GRIZZLIES

NORDBERG MINE HOISTS



Five of the seven 6-cylinder Nordberg 4-cycle Supairthermal diesels serving the Gunnar Mines operation in Canada.



Two 12-cylinder Nordberg 2-cycle diesels rated 9600 hp each, installed in Anglo-Lautaro's Coya Sur power plant.

These steels do cost more—

USS "T-1" Steel lightens world's largest drag bucket.

This 35½-yard dragline bucket – the world's largest – was recently built by the Electric Steel Foundry Company, Danville, Ill. It will be used in the Central Ohio Coal Company's open pit operation near Zanesville, Ohio. The big problem was to obtain the desired capacity, strength and ruggedness with the least possible weight. To do this, the builder used super-strength USS "T-1" Constructional Alloy Steel plate in the sides, bottom and back. No other steel would provide such high yield strength (100,000 psi), weldability, and resistance to impact abrasion.

The completed bucket scoops 106,000 pounds of load but weighs only 69,000 pounds. Of this, 8,500 pounds are USS "T-1" Steel and 12,000 pounds are USS MAN-TEN High-Strength Steel, which has a minimum yield point of 50,000 psi. The weight saved by these two steels goes into extra load capacity and results in lower costs per cubic yard moved.

but they do more — and save more!

Today's mining equipment is the biggest, toughest and brawniest ever built. Much of its ruggedness and long life come from high-strength steels, new grades of super-strong, super-tough alloy steels, and stainless steels. *Special steels make the difference.* Today's special steels for mining equipment are stronger—tougher—more resistant to abrasion and corrosion. Every pound of these steels in your equipment means money well spent. Money that pays dividends by cutting dead weight, increasing payload, extending service life, reducing downtime and saving operating dollars. *USS, Cor-Ten, Man-Ten, Tri-Ten and "T-1" are registered trademarks*

Here are the USS Steels that do more:

USS MAN-TEN Steel—High-strength with abrasion resistance and economy. (Minimum yield point 50,000 psi)

USS COR-TEN Steel—High-strength with superior atmospheric corrosion resistance. (Minimum yield point 50,000 psi)

USS TRI-TEN Steel—High-strength with toughness, weldability and abrasion resistance. (Minimum yield point 50,000 psi)

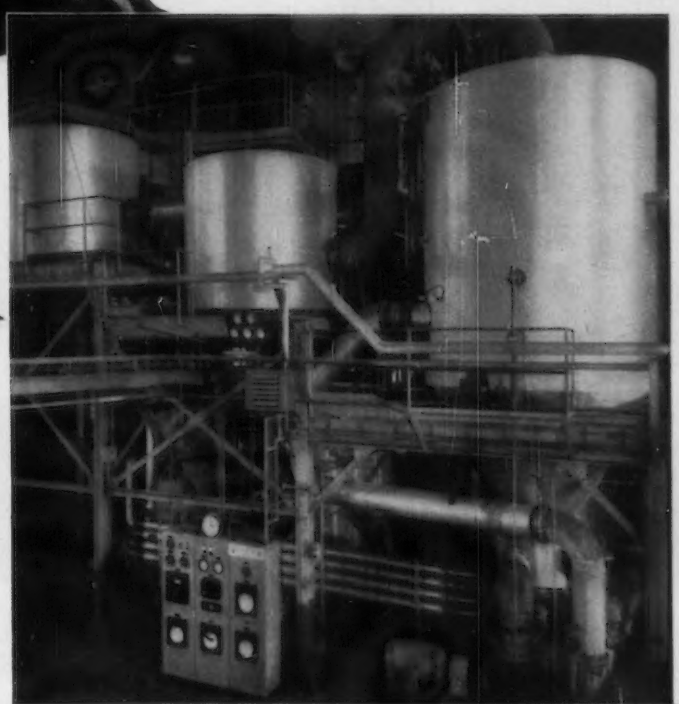
USS "T-1" Steel—Super-strength with impact abrasion resistance, weldability and toughness. (Minimum yield strength 100,000 psi)

USS STAINLESS Steel—High resistance to corrosion, elevated temperature and abrasion.

Each of these USS Steels is superior for certain applications. Our metallurgists will help you choose the best steel for your job. Contact our nearest sales office or United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS MAN-TEN Steel helps cut haulage costs.

This 50-ton Dart coal hauler operates at a rate of 5.9¢ per ton-mile. The old, smaller trucks cost 12.6¢ per ton-mile. These figures include truck operation, truck maintenance and other costs. Contributing substantially to the lower operating rate was the use of USS MAN-TEN High-Strength Steels which enabled the construction of larger trucks having 15% greater capacity than conventional units. In three years' time, no maintenance was required on the new trucks due to USS MAN-TEN Steel's high resistance to abrasion and impact.



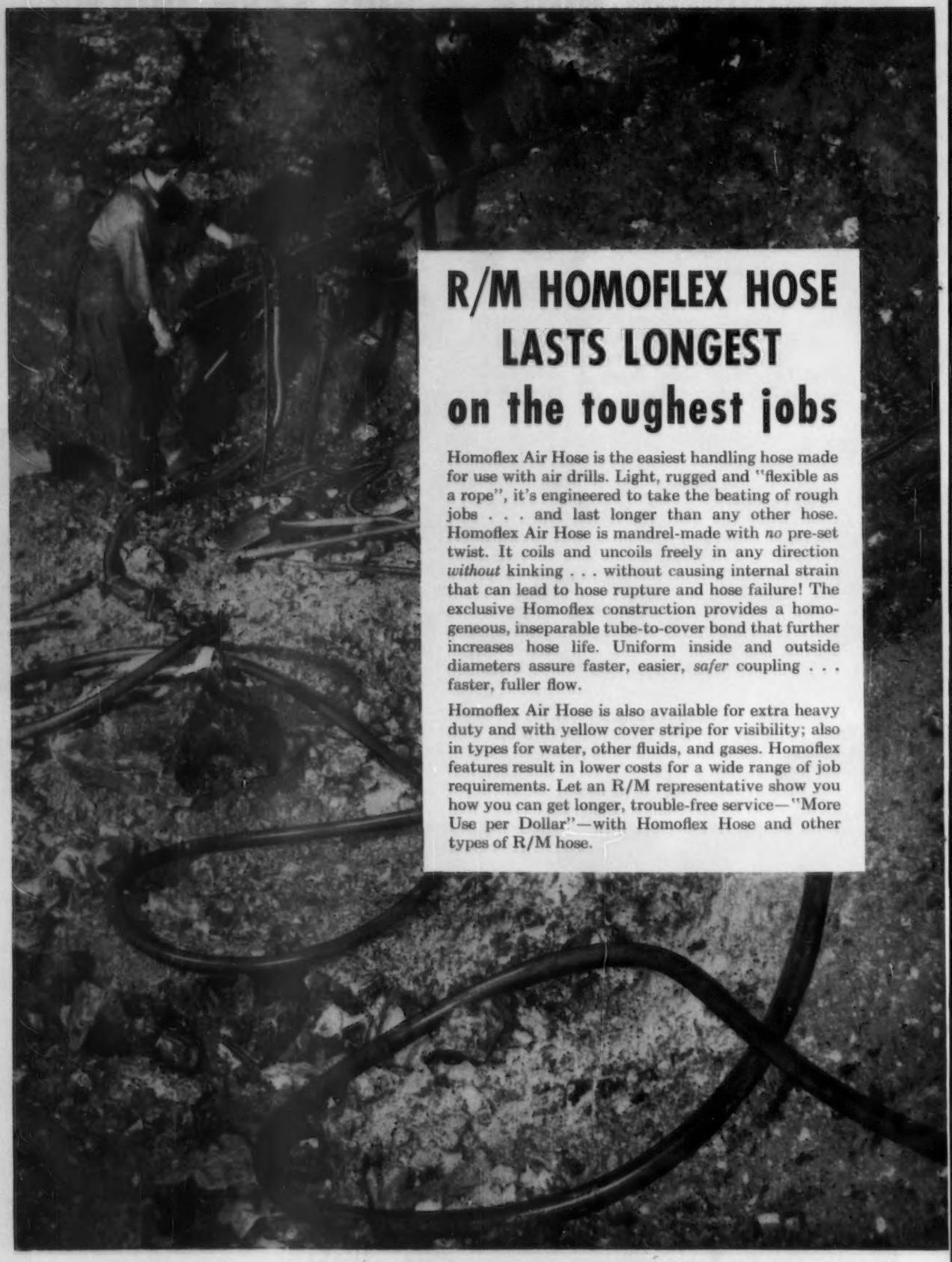
Only Stainless Steel is good enough for this new extraction process.

Sheritt Gordon Mines, Ltd., Fort Saskatchewan, Canada, has a new method for extracting nickel, copper and cobalt from ore. The ore is dissolved in a bath of ammonium sulfate and ammonia and the metals are recovered from solution. Stainless Steel is the only metal that can be used in the pipes, tanks and pumps that give the "hot bath" of ammonium sulfate to the ore. Other materials can't take the corrosion and high temperatures in this work as well. Stainless has proved more economical than any other metal.

United States Steel Corporation—Pittsburgh
American Steel & Wire—Cleveland
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

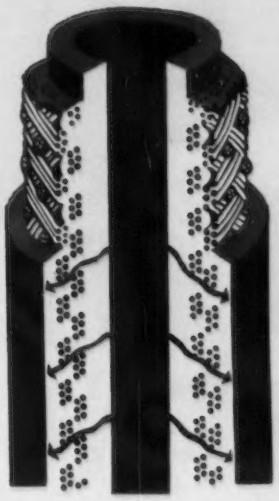
USS



R/M HOMOFLEX HOSE LASTS LONGEST on the toughest jobs

Homoflex Air Hose is the easiest handling hose made for use with air drills. Light, rugged and "flexible as a rope", it's engineered to take the beating of rough jobs . . . and last longer than any other hose. Homoflex Air Hose is mandrel-made with *no* pre-set twist. It coils and uncoils freely in any direction *without* kinking . . . without causing internal strain that can lead to hose rupture and hose failure! The exclusive Homoflex construction provides a homogeneous, inseparable tube-to-cover bond that further increases hose life. Uniform inside and outside diameters assure faster, easier, *safer* coupling . . . faster, fuller flow.

Homoflex Air Hose is also available for extra heavy duty and with yellow cover stripe for visibility; also in types for water, other fluids, and gases. Homoflex features result in lower costs for a wide range of job requirements. Let an R/M representative show you how you can get longer, trouble-free service—"More Use per Dollar"—with Homoflex Hose and other types of R/M hose.



ONLY R/M OFFERS

HOMOFLEX

CONSTRUCTION

More flexible and lighter than any other hose for equal pressure.

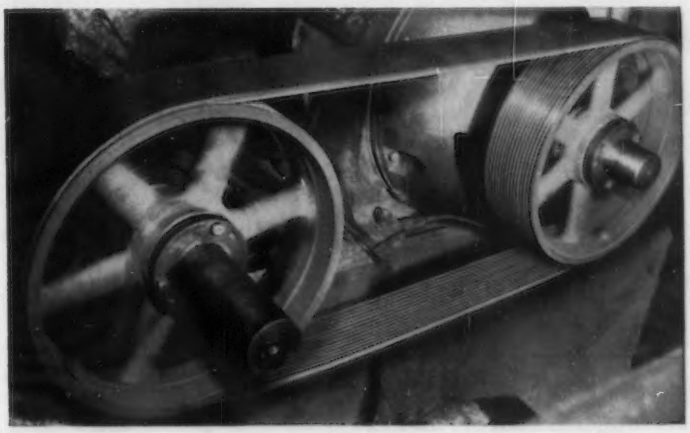
- SUPER-STRONG
- PRECISION BUILT
- FLEXIBLE AS A ROPE
- LIGHT WEIGHT

Note in cross section how specially designed braid permits the rubber tie-gum to penetrate and bond the braided plies during the plastic stage of vulcanization. This results in an inseparable tube-to-cover bond. Write for Bulletins M694 and M610.

"More Use per Dollar"

RAY-MAN CONVEYOR BELT TRAINS BETTER

Ray-Man has the extra flexibility to train naturally, trough easily . . . handle heavier loads. Cushioned strength members *plus* double compensation to relieve outer-ply stress—top *and* bottom—absorb load impact and greatly prolong belt life. Ray-Man really *holds* fasteners, is highly rip resistant . . . requires no breaker strip! Exclusive "XDC" Cover protects against wear, tear, cuts and abrasion. Check advantages of Ray-Man for your job . . . Other types include extra-cushioned Homocord for severe shock loading, and R/M Tension-Master for long lifts, high tensions. Write for Bulletin M302.



R/M POLY-V® DRIVE ELIMINATES BELT MATCHING

Single unit belt (*not* an assembly of V-belts), across full width of the drive-sheave eliminates belt "length-matching" problems. Equipment downtime and belt replacement costs are minimized. Patented Poly-V Drive has *twice* the tractive surface of a V-drive, and delivers up to 50% *more* power in the same space or *equal* power in as little as ⅔ *the space!* Just *two* cross sections of Poly-V Belt meet *every* heavy duty power transmission requirement. Greater power delivery and drive dependability begin when you specify R/M Poly-V* Drive for your mine fans and other equipment. Write for Bulletin M141.

*Poly-V is a registered Raybestos-Manhattan trademark.

RM914

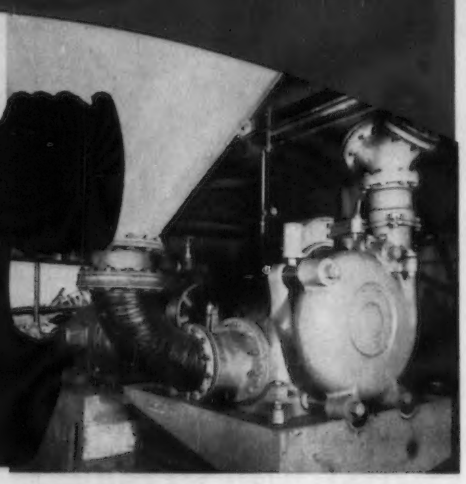
BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

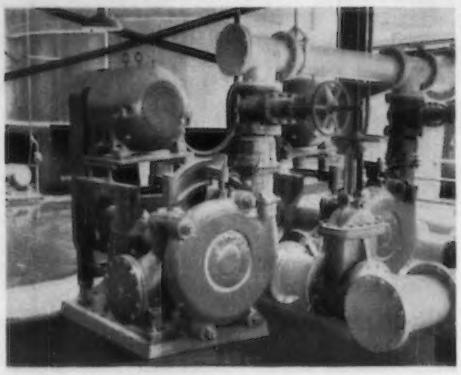
WILFLEY SAND PUMPS



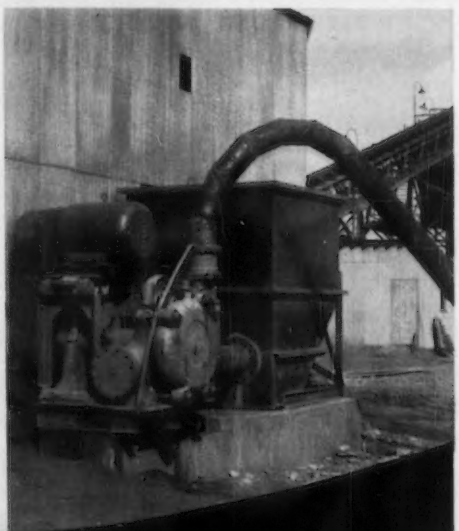
Versatility

to Solve Your SPECIFIC Pumping Problems

Every year the applications for Wilfley Sand Pumps become more varied. So many industries now require low cost pumping of sand, slimes, slurries—abrasive solutions of all types. Wilfley Sand Pumps are designed to meet all requirements in the transfer of solids. They may be fitted with interchangeable electric furnace alloy iron, special application alloys, or rubber-covered wear parts. Whether you need belt driven, overhead V-belt driven, or direct driven pumps, Wilfley has them—available in **1"**, **1½"**, **2"**, **2½"**, **3"**, **4"**, **5"**, **6"**, **8"** and **10"** discharge sizes with capacities to 3600 GPM and heads as high as 200'.



This all-around versatility plus continuous, maintenance-free performance and longer pump life make Wilfley the No. 1 choice of economy-minded plant operators throughout the world. To give you maximum economy in solids pumping, every Wilfley installation is **Job Engineered.**



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ENGINEERING AND MINING JOURNAL

NOVEMBER 1959

The Chinese Had Two Words For It

害 *Disaster*

害 *Advantage*

AT SOME TIME in the evolution of the Chinese language and character writing system, the notion must have arisen that "disaster" and "advantage" are synonymous, or at least closely related, because today both words are represented by the identical characters shown above.[1]

If we accept the idea that disaster can be turned to an advantage, we may find a way to prevent future mine disasters. Let's consider two metal mine disasters, which in terms of lives lost, were the worst in recent mining history. In both instances, they were accidents which even the most prudent or safety-conscious management might fail to foresee. One would say that they were accidents which couldn't happen. And yet they did. In both disasters, the miners who died suffered no outward evidence of physical injury. In both tragic events, the fatalities were caused by the inhalation of lethal combustion products which were sucked into the mine ventilation stream under unforeseeable circumstances.

What we can learn to good advantage from these two disasters is that future accidents of a similar nature can be prevented if we will but recognize that an underground mine is, in reality, a large ventilating duct. The gases entering that duct can be lethal or life-sustaining—depending upon what they are.

Next we should try to imagine every conceivable circumstance that might arise to contaminate the duct with lethal gases; then take action to prevent such circumsances from ever occurring. And finally we must assume that despite these precautions, some unpredictable combustion might still pollute the air stream. Acknowledging this possibility, it then becomes the responsibility of management and the safety department to establish stench alarm systems, remote-controlled fire doors, escape rooms, fan control systems, fire drills to evacuate the mine speedily and other measures to divert the lethal gases away from the miners, or isolate the miners from the gases until rescue is possible. These are exactly the measures subsequently taken by those who were unfortunate enough to experience the disasters mentioned above.

Here are additional suggestions that might be adopted in a good safety and disaster-control program:

1. It is now possible to fireproof mine timber with the same equipment that is used to pressure-proof timber against decay. See p 118.

2. Poor housekeeping at the portal or at the collar of the shaft can mean a conflagration which will introduce lethal gases into the mine. If possible, all structures in such places and on shaft stations should be concrete and steel.

3. All lubricants and other flammable materials used underground should be kept in fireproof rooms with doors that can be closed to contain possible fires.

4. Electrical fires are still tops on the list of hazards. All equipment such as switchgear and transformers, particularly those filled with flammable oils, should be installed in fireproof rooms equipped with fireproof doors. In one mine, a small hole with steel slide is provided to permit the insertion of a fire extinguisher nozzle to put out possible electrical fires.

5. Conveyor belts should be installed in clean set-ups that will preclude ignition. Some manufacturers make belts that will not support combustion.

Finally, getting back to the original disaster-advantage theme, let's remember that it's not the accident that could happen that causes disasters—it's the accident that couldn't happen!

[1] We are indebted to the research library of King Typographic Service in New York for the information on Chinese characters used above. Authority consulted was Matthews, character No. 2015. King Typo sets type in more than 600 languages for United Nations and other clients.

OPEN-PIT MINING at Haverlahwiese near Salzgitter-Gebhardshagen. The dragline rests on top of the orebody.

Salzgitter Brown Iron Ores Basis for a Second Ruhr

JOHN B. HUTTL

DURING A RECENT SOJOURN in Germany, an editorial came to the attention of E&MJ in one of the country's most respected magazines, V.I.R., which starts out as follows (translation):

"The Bundesrepublik is not quite as poor in regard to mineral wealth as is generally assumed. In the list giving the mineral holdings of the world's leading nations, Germany, without the territories east of the Bundesrepublik, ranks fourth behind the United States, the Soviet Union, and Venezuela. Since ore requirements are rising constantly, German mines will have to increase production accordingly. This is also a question of investments and availability of capital because the funds required for exploration, development and expansion must flow at the right time and to the right place."

Accustomed to looking upon Germany as a "have-not" nation, this statement was indeed startling and one worthy of investigation. Consultation with German authorities and trips through the principal mining regions revealed that the area that has contributed most to the sum total of German mineral resources is the Salzgitter brown iron ore mining district in Niedersachsen, with the city

Table 1. Major European Iron Ore Reserves

Deposit	Ore Reserves	Av. Fe Content
Lorraine	6000 mill. tons	31%
Central Britain	3000 " "	30%
North Sweden	2000 " "	61%
Salzgitter	2000 " "	28%

Table 2. Chemical Composition of Iron Ores in the Salzgitter Region

Type	% Fe	% SiO_2	% Al_2O_3	% CaO	% MgO	% Mn	% P
Upper Cretaceous Ores							
Peine	23.5	8.7	2.0	22.5	1.95	2.85	1.00
Bülten	25.0	6.5–7.5	0.8–1.5	23.0	1.70	3.60	0.6–0.9
Lengede	28.0	15.1	4.5	16.5	0.80	0.40	1.47
Lower Cretaceous Ores							
Salzgitter	29.5	25.5	8.5	4.5	1.50	0.16	0.42
Upper Jurassic Ores							
Coral Rag (Oxford)							
Upper Bed	26.7	19.1	7.6	12.0	1.60	0.23	0.26
Lower Bed	29.8	15.3	5.2	13.0	3.00	0.22	0.32

of Braunschweig as the hub. Here some 2-billion tons of low-grade iron ore have been found and developed in recent years which, after upgrading in large, modern plants, furnish feed for the local blast furnaces of Salzgitter AG, one-time Reichswerke Herman Goering, and Ilseder Hütte, and to a lesser extent to those operated at different localities in the Ruhr Valley. Iron and steel production from the plants is the fuel for the multitude of factories and plants which dot the Salzgitter countryside today. New enterprises are being established, aside from expansion of existing mining, smelting, and manufacturing facilities.

Table 1 shows that the Salzgitter deposits are the fourth largest source of iron ore in Europe. They have in part replaced the Minette iron fields in Lorraine lost to France after World War I. Presence of iron ore in the district has been known for nearly 2,000 years. Charcoal furnaces dating back to the second and third centuries have been unearthed in 1953 between Salzgitter- Lobmachtersen and Salzgitter-Heerte, and there are records of sporadic small-scale attempts at mining and beneficiation since then and up to the 18th century. In fact, a tax list published in 1311 mentions 38 smelting works near Immenenrode which were delinquent in their tax payments. The first geological investigations were made in the early part of the 19th century. Completion of the railroad Braunschweig - Börsum - Salzgitter - Seesen in 1856 sparked new interest in the known deposits, bringing about a revival of mining and establishment of various smelting enterprises, Eisenwerke AG Salzgitter, defunct in 1873, and Ilseder Hütte, now more than 100 years old, among them. Annual pig iron and steel production of Ilsede today averages 700,000 and 800,000 tons respectively. Wherever possible, ore was mined by open pit methods, the low cost offsetting to some extent the high cost of coal brought in by rail from the Ruhr mines. In general, activities carried on in the district after the Franco-Prussian War were on a relatively modest scale. Chief deterrents to expansion were high costs for transportation of finished products and materials, and the coal mentioned before, the district having no coal deposits within its boundaries or near by, and the difficulty in smelting some of the sour ores known then. Construction of the Midland Canal, which reached Peine in 1929, and the 18-km-long southerly branch built later to Salzgitter, materially reduced transportation costs, improving the competitive status of the district.

Serious attention was given the dis-

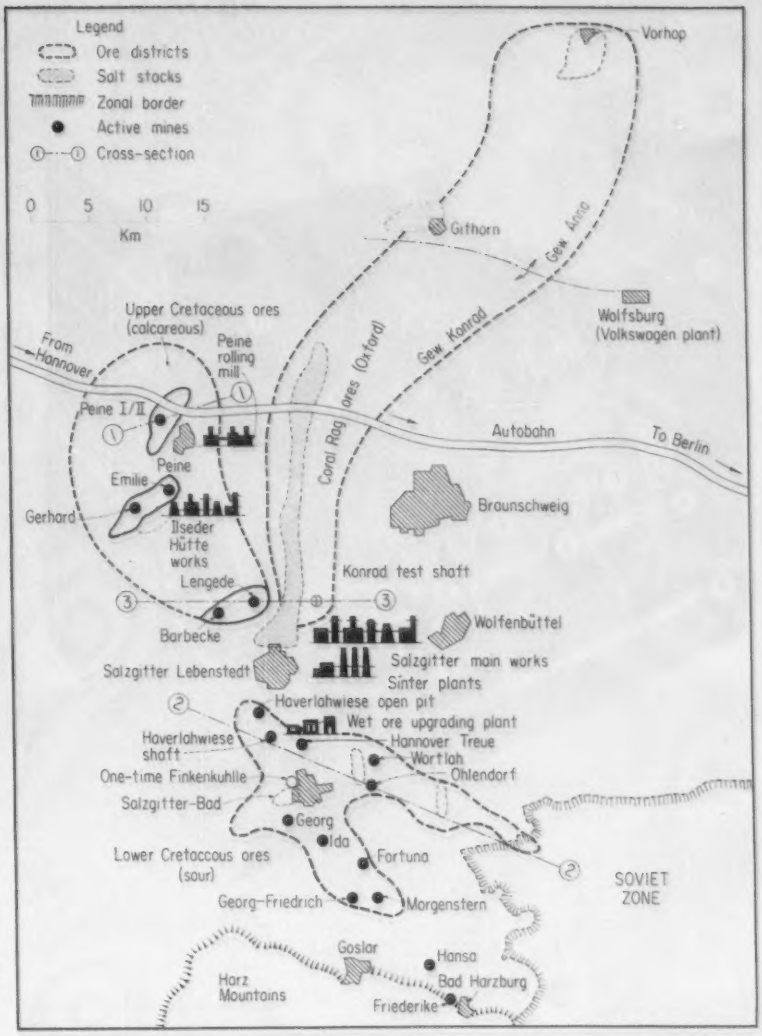


FIG. 1. Location and outline of three principle iron ore deposits in the Salzgitter district. (After Dr. H. Kolbe)

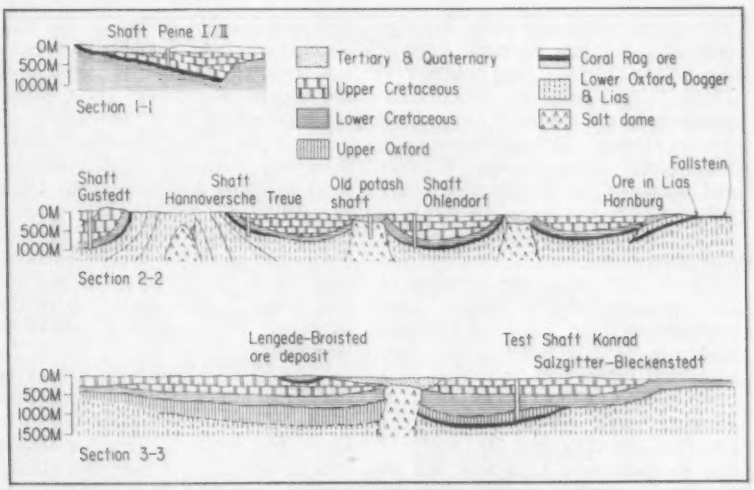


FIG. 2. Cross-sections of orebodies shown in Fig. 1.

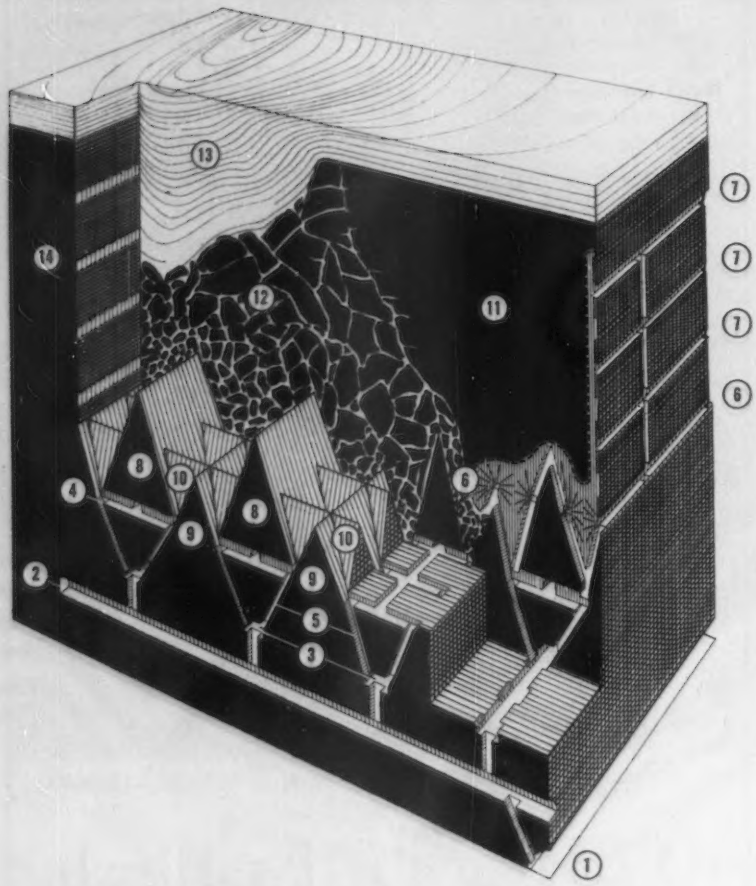


FIG. 3. Block-caving method employed on Salzgitter ores.

LEGEND

1. Main haulage drift
2. Scraper drift
3. Shaker drift
4. Grizzly drift
5. Ore passes
6. Undercuts
7. Undercuts
8. Main roofs above grizzly and shaker drifts
9. Intermediate roofs parallel to main roofs
10. Cross roofs at right angles to 8 and 9
11. Standing block
12. Broken block
13. Caving mass
14. Leg pillar, or adjoining block

trict by the government and the iron and steel industry after the loss of the Alsace-Lorraine iron holdings in 1919. To this end, the Erz-Studiengesellschaft GmbH was formed, of which Hoesch, Deutsch-Luxemburg, Rheinstahl, Gelsenkirchen Phoenix and others of the Westphalian heavy industry were members. An extensive drilling and exploration campaign was carried out in the district from 1919 to 1923 under the direction of the geologist Johann Weigelt, later professor at Halle. The large tonnages of low-grade iron ore found in new areas and subsequent perfection of a process for economic benefication of Salzgitter ores, which are sour, by Dr. Prof. Paschke and Dr. Peetz of the Bergakademie Clausthal led to the development of several open pit and underground mining enterprises and to the establishment of the huge Reichswerke AG in 1937. The resultant upsurge of activities lasted until the end of World War II. A period of dismantling and destruction of plants down to the concrete foundations with attendant mass unemployment followed and lasted until 1950. Permission to rebuild was granted that year by the occupation powers. Since then there has been a phenomenal upswing in activity and the district today is once again one of the important iron and steel centers in Germany.

Location and boundary outlines of the three principal iron ore deposits in the Salzgitter district are shown in Fig 1. The Santonian(Emscher-Senon) ores in the Upper Cretaceous (Oberkreide) formation of the Peine-Ilsede area, which are calcareous, have been exploited by open pit and underground methods since the middle of the 19th century and today provide the bulk of feed for the Ilseder Hütte plant. Slightly southwest are the sour Neocom ores in the Lower Cretaceous (Unterkreide)formation along the Salzgitter anticline(Salzgitter Höhenzug)which were developed for large-scale operations prior to the erection of the Reichwerke plants in 1937 and represent the principal ore supply for the rebuilt Salzgitter AG works.

A Recent Discovery

The third and largest source of iron ore—a relatively recent discovery awaiting development— are the Coral Rag (Korallenoolith) ores occurring in the Oxford formation of the Upper Jura (Oberjura) within a long and deep trough extending from Salzgitter-Lebenstedt in the south to Vorhop in the north. The first indication of iron ore was disclosed while drilling for oil near Gifhorn in 1933. Subsequent drilling has disclosed huge tonnages of mineable iron ore. It is estimated that these deposits, together with the Neocomian and Santonian ores mentioned, represent 65 to 75% of Germany's total iron ore resources. At this time, the indicated and developed ore reserves of the district approach the 2-billion ton mark.

All ore deposits found so far in the district are of the sedimentary type. Deposition of iron-bearing material in large troughs or depressions occurred in the Under Cretaceous period near the coastline of the Neocomian Sea, which extended from Gusted via Klein-Mahner and Schladen to a point south of Hornburg (zone border), forming along its way numerous bays and inlets. The iron-bearing material originated in the limonite-weathered Jurassic siderite concretions during the Neocomian Age. Presence of and rising salt domes below the subsoil strata aided materially in the formation of large ore deposits at their flanks. When plastic salt gradually moved away, large depressions resulted in which the iron-bearing material collected. Later on, rising salt uplifted the ore deposits, together with associated strata, with the result that many deposits outcrop on both sides of the Salzgitter anticline (Salzgitter Höhenzug), dipping 70° to 80° west or east. Ore beds found vary in thickness from 2 to 100 m and in depth from 0 to 1400 m.

Mineralogically the deposits consist of brown iron ore. The iron-bearing minerals are in part chemical precipitates of limonite (oolithes) and in part fragments of more or less strong limonitic sphaerosiderite con-

cretions. Some layers contain grains of hematite, magnetite or siderite. The precipitates are found in the form of ooides minus 1 mm in size and as incrustations on the different material, and the geode fragments as large fractures measuring in size up to 50 mm or as very fine(worn rock) particles minus 0.25 mm in size.

Ore deposition lasted throughout the entire Neocomian period and up to earliest Under Albian. It was not a continuous process. Frequent earth movements caused many changes in the flow patterns of currents along the coast of the shallow sea and in such a way that deposition occurred in areas close to the shore.

In the ore horizon proper there are seven distinct beds, some of which adjoin each other very closely while others are parted by barren intermediate clay banks. The Hauterivian deposits in the main are oolitic and the Upper Barremian and Aptian more conglomerated. In some mines, the ore horizon is not always fully developed, with the result that in one mine the oolitic ores prevail and in the other the conglomerated type. The iron-bearing minerals are not uniform in composition, and metal content varies considerably. For instance, that of the ooide ranges between 52 to 43%, depending on the nucleus of the ooide(Ooidkern). Iron content of the geode fragments ranges from 38 to 45%. The limonitic materials contain 5 to 10% SiO_2 and the nucleus of the ooide(Ooidkern) consists of quartz.

Sediments Are Leached

The sediments have been subjected and today are still subjected to the influence of descending waters containing carbon dioxide. This action causes leaching and corrosion with consequent deterioration of the iron carriers. The ooide and geode fragments disintegrate. It is a reconversion of limonite to carbonate or sphaerosiderite. The iron joins the binding agent, cements it, and makes it hard. Total iron content need not be reduced by this action. When ores are treated in a mechanical plant using wet processes for the purpose of upgrading (the large 22,500-tpd wet plant at Salzgitter-Calbrecht is described in the article on p. 87) this phenomenon can bring about high iron values in final tailings and relative poor enrichment of the concentrates produced. In fact, the deterioration mentioned may reach a point where the iron carriers completely disappear. In addition to the principal components mentioned, some ores contain a quantity of sand partly impregnated with iron, glauconite, and small quantities of lime in the form of fossil residue and as clay marl. Size of the sand particles is minus 40 microns in the clayey and oolitic ores and up to 1.5 mm in the conglomerate ores. Sulphur minerals, chiefly pyrite, occur in clayish stripes. The pyrite is in part oxidized, fixed through lime, and encloses ooides with a white skin of gypsum. An average analysis of mined ores is as follows: Iron, 28%, SiO_2, 26%; CaO, 5%; and AL_2O_3, 9%. Additional ore data are given in Table 2.

While the Santonian ores in the Upper Cretaceous lie between 100 and 640 m and those in the lower Cretaceous at depths of 900 m plus and outcrop at different points, the recently discovered Oxford Coral Rag ores in the Upper Jura occur at depths below 1,000 m and do not outcrop. They are large flat-lying beds with dips ranging from 5 to 20 deg. Exploration has disclosed two ore horizons, the upper and the lower, in which ore thicknesses from 0 to 10 m and 8 to 20 m, respectively, are found. The barren zone separating them ranges from 10 to 25 m in thickness. The ore found in the lower part of the long, north-south striking trough area up to Gifhorn is older than the Lower Cretaceous and Upper Cretaceous ores mined in the Peine-Ilsede and Salzgitter districts. Overburden consists of marbles, clays and limestones laid down during the

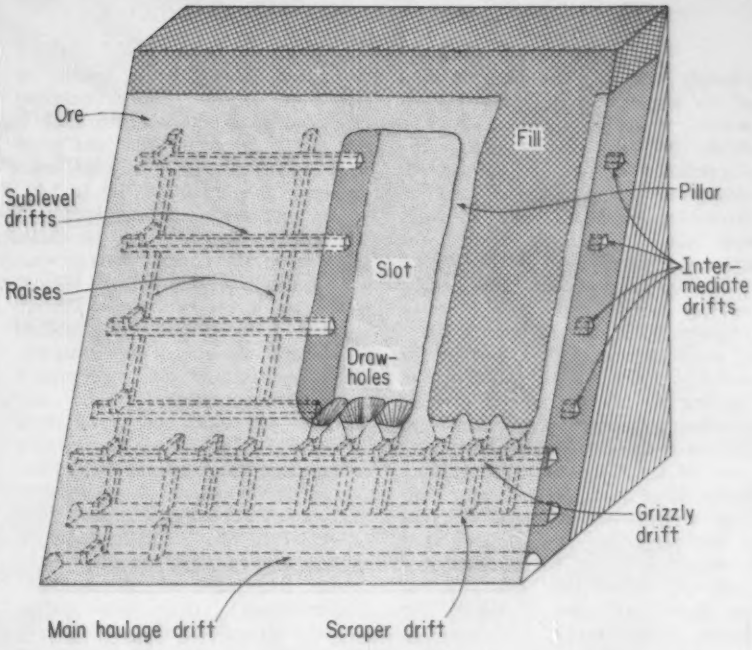


FIG. 4. Sublevel stoping method involves both grizzly and scraper drifts.

STEEL HEADFRAME over Shaft Georg near Salzgitter-Gitter.

younger periods. The western limit of the ore deposit is formed by salt domes, which in other places also divide the ore district itself. The composition of the ore corresponds closely to its paleographic position. Mineable ore beds grade outwards into thin calcareous or sandy layers comparatively poor in iron.

The ore proper is solid and lumpy, and like the Minette ore in Lorraine it resembles, is fine and porous. Color of the better grade ore is red like that exploited in the Lahn-Dill region. Exploration of the area continues, including the sinking of the large 1200-m test shaft Konrad only 1 km north of the Salzgitter iron and steel works. Some of the ore beds found are large enough to warrant construction of surface plants and underground development for an ore production of 5,000 tpd. When fully developed, the new district will provide ores for the Ilseder Hütte works, the Salzgitter AG works, and others to come for many decades. To give an idea of the job ahead, it may be of interest to cite some of the figures covering development of the Salzgitter area in the south. Between 1939 and 1944 there were drilled 359 prospect holes to depths ranging from 300 to 1400 m and representing a total length of 145 km, some 10,675 m of shafts and winzes; and lateral openings with a total length of more than 74 km.

The major ore production centers established by Salzgitter AG include the Haverlahwiese open pit and underground mines, and the underground mines Hannoversche Treue, and Wortlah. Combined ore production averages 25,000 tpd. This figure could be increased an additional 10 to 15% through development of known ore reserves and construction of a new mine surface plant. Mining methods applied underground include block-caving and sublevel stoping(Weitungsbruchbau). Operations underground are mechanized wherever possible. Output per man per shift underground is as high as 10 tons. Underground mines operated by other companies in the districts are shown in Fig 1. An open pit is nearing the production stage along the Broistedt-Vallstedt Road. It opens ores occurring on the eastern flank of the Lengeder Basin for exploitation. Operations carried on underground at the mines owned by Ilseder Hütte and others differ little from those operated by Salzgitter AG.

Information contained in the aforegoing report was obtained in part through interviews with executives of Salzgitter AG headquartered at Salzgitter-Calbecht; and in part from literature released by the management of Salzgitter AG, including Dr. H. Kolbe's articles "Das Eisenerzgebiet bei Salzgitter(Bergbau Rundschau, July 1949), and "Die Erzablagerungen im Salzgittergebiet"(Geographische Rundschau, March 1958). E&MJ also wishes to express its gratitude to the management of Salzgitter AG for the many courtesies shown it during the recent visit to mines and plants.

How Salzgitter Brown Iron Ore Is Upgraded to Blast Furnace Feed

JOHN B. HUTTL

THE SOUR NEOCOM ORE produced by Salzgitter AG's principal open pit and underground mines contains about 28% iron and 26% SiO_2, and as a consequence cannot be smelted direct in the blast furnace. To provide a satisfactory feed for the company's six large blast furnaces (a seventh is under construction), it is necessary to raise by wet process the iron content to 38% and to lower the SiO_2 content to about 16% preparatory to sintering, the ultimate upgrading step. This is being accomplished in the modern 22,500-tpd plant at Calbecht to be described in detail.

Origin and composition of the ores treated at Calbecht have been described in a separate article (p 82). To recapitulate briefly: The Salzgitter deposits, like those in the Peine-Ilsede area to the north, are of the marine sedimentary type laid down in shallow basins or troughs during the Cretaceous period. Near Salzgitter they occur in the Lower Cretaceous formation up to depths of 900 m plus, outcropping at points of uplift. The ore is medium hard, lumpy, and porous, and is mined by block caving and a modified cut-and-fill method of stoping (Weitungsbruchbau). The principal properties furnishing feed for the central upgrading plant today include the Haverlahwiese open pit, which provides about 5% of the total, and the underground mines Haverlahwiese I, Georg, Hannoversche Treue, and Worthlah-Ohlendorf, all served by modern surface plants. Mined ore is brought to the storage bins at the head of the plant in 75-ton Talbot side-dump cars over a standard-gage railroad system operating between the mines and plant proper. Maximum haulage distance is 15 km.

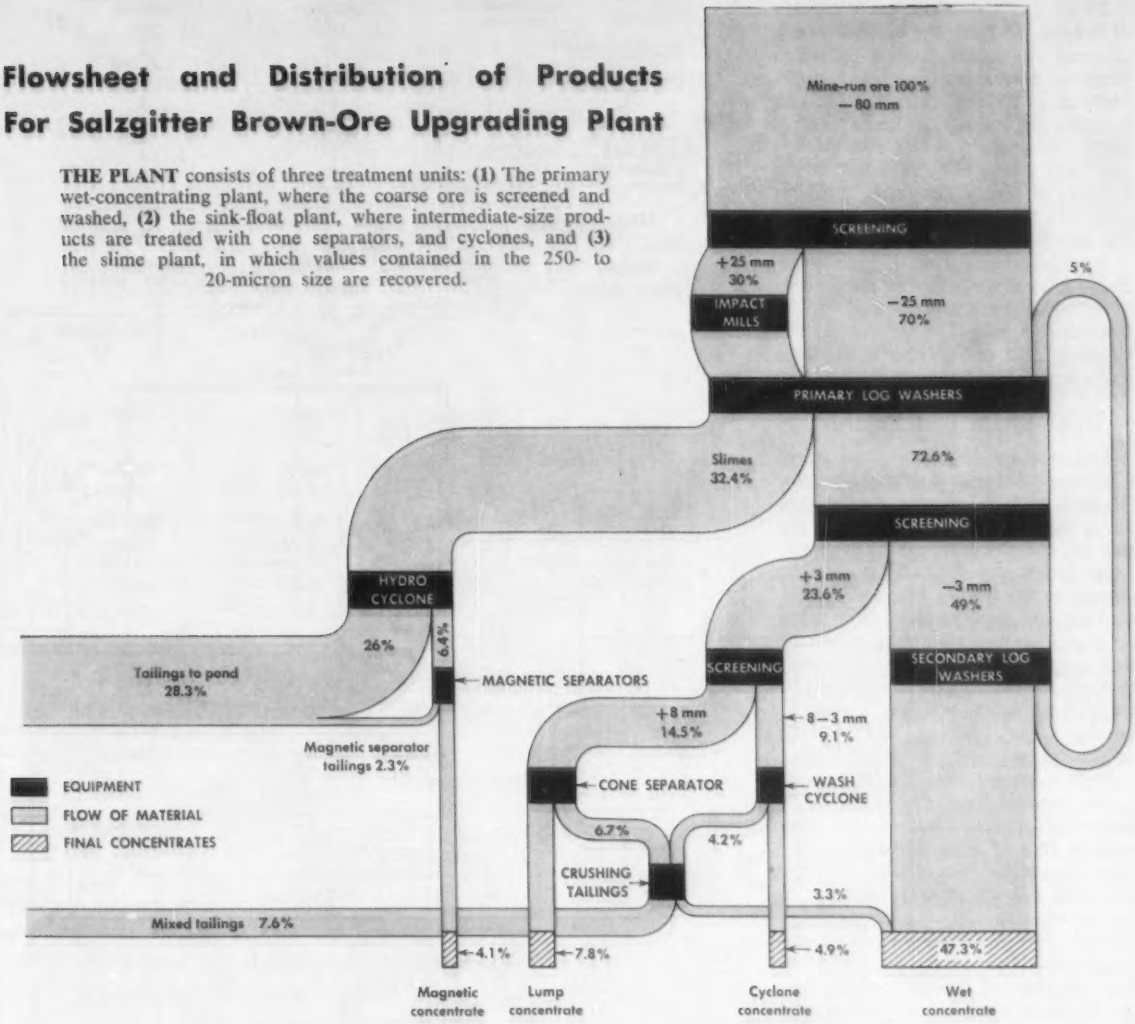
The upgrading plant consists of three separate treatment units—namely, (1) the primary wet concentrating plant in which the 150-mm mine-run ore is reduced to 80-mm plant feed by two-state crushing, screened, and washed in special log washers; (2) sink-float plant with cone separator vessel and cyclone separation for respectively treating the plus 8 mm material and minus 8 mm to 3 mm material from the secondary washing section; and (3) the slime treatment plant in which iron values contained in material of 250 to 20 micron size are recovered. Iron content of the finished products subsequently sent by rail to the sintering plant at Heerte are as follows: wet concentrates, 38%; cyclone concentrates, 33%; sink-float concentrates, 31%; and magnetic separator concentrates from slime plant, 33%. Volume percentages are shown in the diagrammatic flowsheet of the upgrading plant. Operations carried on in the different plant units and equipment used are explained in detail in the standard plant flowsheets.

Primary Concentrator

Ore storage facilities available at the head of the plant consist of a slot bin or bunker of novel design capable of holding 1,000 tons, and three auxiliary concrete bins with a total capacity of 50,000 tons. All four bins are installed below rail level. The slot bin has slots above the table-like bottom extending the entire length of the front wall and the back wall, the front slot serving as discharge point. Stored ore is discharged onto the long, wide steel apron feeder serving the belt conveyor leading to the crushing section of No. 1 screening and ore wash-

Flowsheet and Distribution of Products For Salzgitter Brown-Ore Upgrading Plant

THE PLANT consists of three treatment units: **(1)** The primary wet-concentrating plant, where the coarse ore is screened and washed, **(2)** the sink-float plant, where intermediate-size products are treated with cone separators, and cyclones, and **(3)** the slime plant, in which values contained in the 250- to 20-micron size are recovered.



ing department of the plant by a unique mechanism. It is pushed onto the apron feeder rather than dropped, thereby reducing wear to a minimum. In fact, the feeder has handled more than 10-million tons without requiring any repair or showing wear. The discharge mechanism consists of a slow revolving 4-m dia steel wheel mounted on the cross-slide assembly like that of a lathe on a truck operating on a track installation running parallel with the slot in the back wall of the bin. Operation is mechanical. The ore is constantly pressed through the slot in the front wall of the bin by the pressure the wheel exerts on the ore exposed in the slot in the rear wall as it travels back and forth on the rail track. The discharge rate is regulated by varying the speed of the truck.

Three standard concrete bins are used for storing reserve ore or in the event of shutdown of the crushing and screening section. During a shutdown, ore stored in the bins is transferred to elevated 75-ton surge bins by cranes with clamshell buckets (three units with tractive power of 25, 20, and 15 tons), whence steel apron feeders direct it to the primary roll crushers ahead of plant Sections 1 (new) and 2. These two units are in operation only when the large primary impact crusher served by the slot bin is shut down for repairs, or if no ore is available for the slot bin.

Primary Crushing by Impact

Crushing equipment in plant Section 1 served by the slot bin and two concrete auxiliary bins consists of a large Hazemag impact crusher, a primary Krupp roll crusher, and a secondary Krupp roll crusher. Plant Section 2 contains a primary Humboldt roll crusher, and two secondary Humboldt roll crushers. Normally, all primary crushing is done by the large impact unit mentioned. It handles the 150-mm oversize material from the steel grizzly ahead. Crusher product minus 150 mm in size and grizzly undersize go via belt conveyor to a vibrating screen ahead of the secondary roll crusher. The screen undersize is belt-conveyed direct to the feed bins serving the screening and washing departments of plant Sections 1 and 2. Screen oversize goes via a picking belt to the secondary roll crusher for reduction to 80-mm plant feed. A second vibrating screen is installed between elevated surge bin No. 2 and the primary roll crusher. No screen ahead of the primary roll crusher is done in the crushing department of plant Section 2. As in plant Section 1, picking belts are operated between the primary roll crusher and the two secondary roll crushers. The seven feed bins ahead of the concentrating department of the plant, in which the minus 80-mm final crushing plant products are stored, are served by three incline belts.

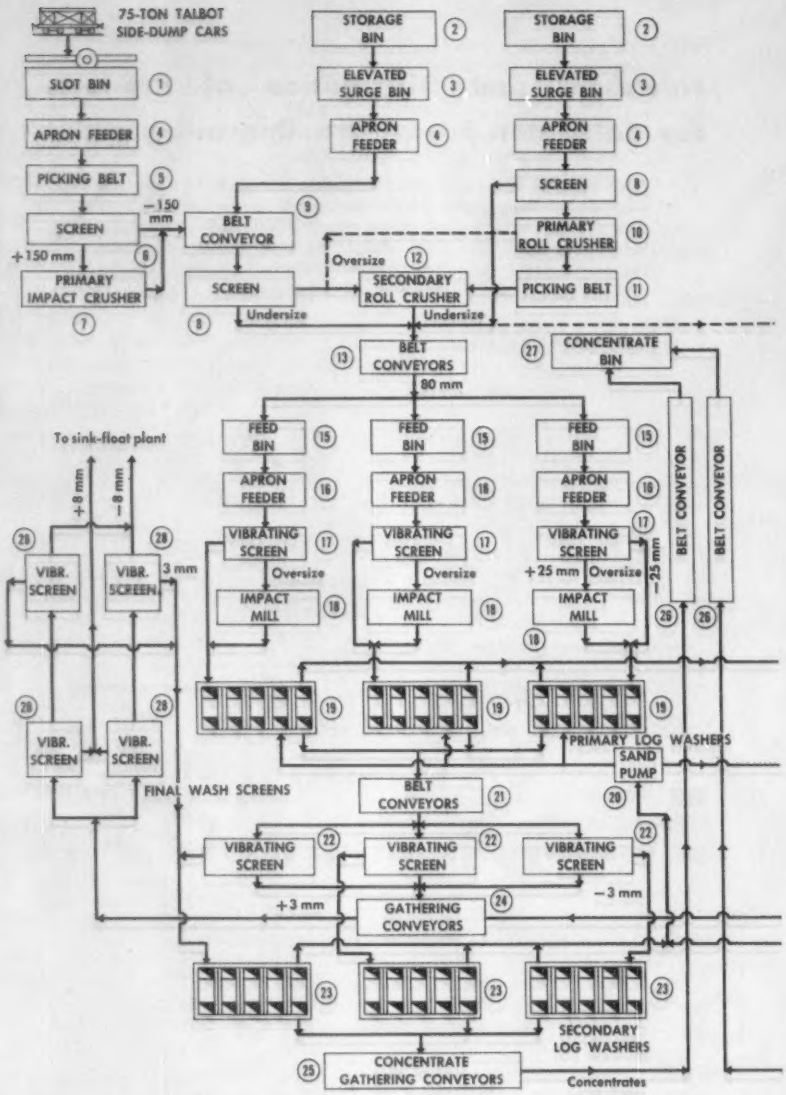
From the feed bins, each capable of holding 15 tons, the crushed ore is directed via apron feeders to lx2-m vibrating screens equipped with decks containing 25-mm openings. Screen oversize is treated in SAP4 impact mills. Undersize, together with the impact mill product, flows direct to log washers of special design. In the beneficiation of Salzgitter ores, the milling step is important because through it the higher grade ore is greatly reduced in size, while that of the gangue in general remains unaltered. It is, therefore, possible to obtain an enrichment of 4 to 5% iron in the finer particle size simply by screening.

Three-Stage Log Washers

Log washers are three-stage washing units with sword-shaped troughs. Washed material leaves the washer via a bucket wheel operating at the end of the third trough. The wash water is fed into the washer countercurrent to the flow of the ore. During the washing process the water takes on clay, fine quartz particles, and very fine gangue material with the result that the washer overflow carries 140 to 160 gpl solids and has a specific gravity from 1.09 to 1.11. If the specific gravity is below these figures a higher current velocity will result in the washer, brought on by high inflow of makeup water with consequent loss of iron particles in the slime. A similar loss of iron particles will occur if the specific gravity of the overflow is above the figures indicated. Specific gravity readings are frequently taken on the washer overflow, and rate of flow of makeup water to the washer is adjusted manually whenever there is a rise in specific gravity above normal. Wash water added to the washer amounts to about 1.8 m³/t.

High-Speed Conveyors

Rougher concentrate produced in the primary washer section is transported over fast-moving (3 m/sec) incline belt conveyors to the vibrating screens ahead of the secondary washers. Minus 3-mm undersize flows to the washers, which differ from the primary washers in that they have two troughs instead of three. Oversize is belt-conveyed to the final wash section containing four vibrating screens ahead of the sink-float plant. Overflows from the washers carrying 50 gal solids are returned to the primary washer section. Finished concentrates containing from 28 to 30% moisture are transported over two incline belts to an 8,000-ton loading bin. Moisture content is reduced to 25% while the material travels over the belts and to about 13% in the storage bin which



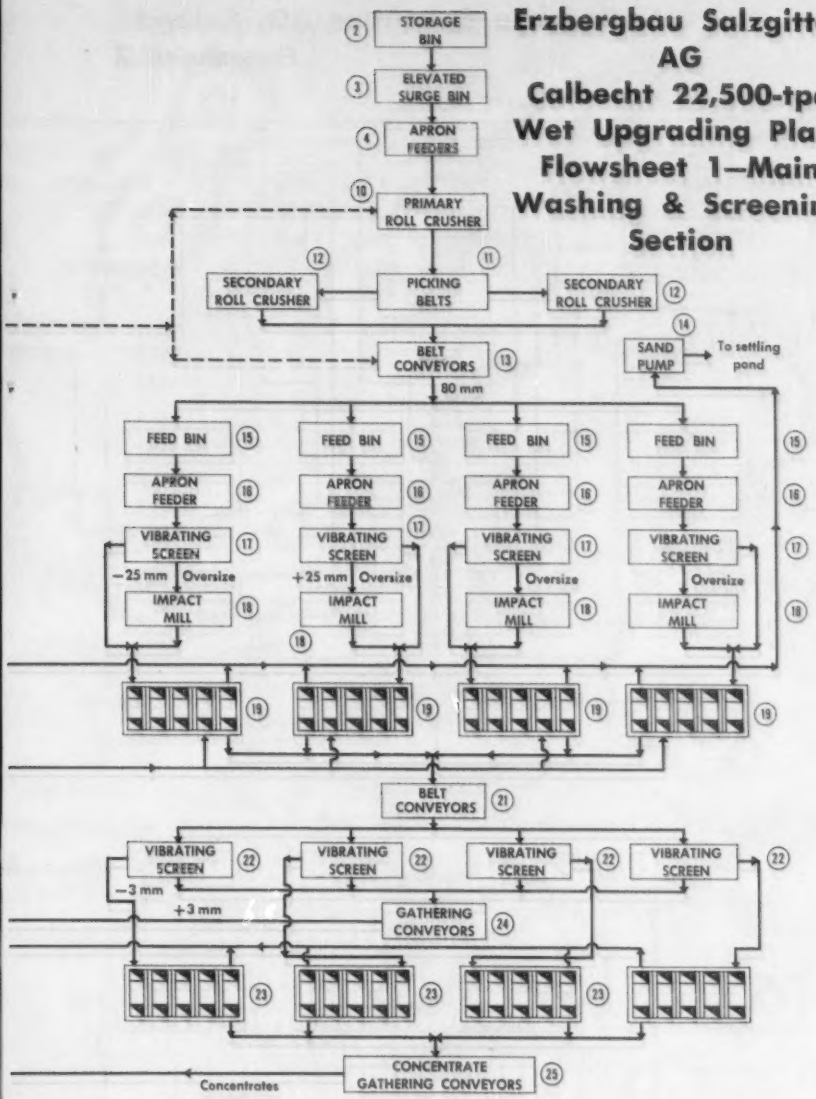
LEGEND

1. 1000-ton slot bin below rail level
2. Three concrete storage bins Combined capacity, 50,000 tons
3. Three 75-ton surge bins
4. Four steel apron feeders
5. Rubber picking belt
6. Screen
7. Hazemag primary impact crusher (capacity, 500 tph)
8. Two screens
9. Belt conveyor
10. Two primary roll crushers (Humboldt and Krupp)
11. Three picking belts
12. Two Humboldt and one Krupp secondary crushers
13. Three incline belt conveyors 650 and 800 mm wide

Production Data Covering Period 1950-57

Year	Tons treated	% Fe in ore	% Fe conc.	% Fe recovery	Kwh/t	H_2O m³/t
1950	2,330,000	30.60	40.84	82.9	5.5	3.0
1951	3,471,500	30.38	40.02	82.0	3.7	2.3
1952	4,183,020	29.61	39.56	81.0	4.1	2.3
1953	3,738,300	28.73	38.73	77.7	4.4	2.3
1954	3,655,400	29.50	39.32	77.2	4.8	2.3
1955	4,754,220	28.77	39.26	77.7	5.9	2.1
1956	5,112,210	28.12	38.36	80.9	6.9 XX	2.0
1957	5,431,960	27.81	37.59	82.1	6.4	2.0
1958	5,574,180	28.30	37.57	82.5	6.3	1.9

XX Without slime treatment plant 5.0 kwh per ton.



Erzbergbau Salzgitter AG Calbecht 22,500-tpd Wet Upgrading Plant Flowsheet 1—Main Washing & Screening Section

14. Centrifugal sand pump
15. Seven 15-ton feed bins
16. Seven apron feeders
17. Seven vibrating screens, 1x2 m, 25-mm openings
18. Seven SAP4 impact mills
19. Seven sets of Salzgitter primary log washers
20. Centrifugal sand pump
21. Inclined belt conveyors
22. Seven vibrating screens
23. Seven sets of Salzgitter secondary log washers
24. Gathering conveyors for minus 3 mm material
25. Gathering conveyors for final concentrates
26. Twin belt conveyors
27. 8000-ton concentrate storage bin
28. Four final washing screens

Operational Data Covering Wet Upgrading Plant

	% Weight	% Fe	% SiO_2	% CaO	% Fe recovery
Mine-run Ore	100.0	28.01	26.22	5.48	100.0
Wet concentrate −3 mm	47.3	37.55	16.82	4.35	63.6
Concentrate +8 mm	7.8	30.23	20.28	7.90	8.4
Cyclone concentrate 8 −3 mm	4.9	32.66	17.64	7.60	5.7
Magn. sep. concentrate	4.1	32.86	22.00	4.30	4.9
Tailings	7.6	13.78	40.79	7.88	3.7
Slimes	28.3	13.74	37.98	5.16	13.7

is equipped with drainage facilities in the floor and sides.

Sink-Float Plant

Screens in the final wash section produce two separate oversize products—one plus 8-mm and the other minus 8-mm to 3-mm. The coarser material is fed for the cone separator and the finer for a cyclone washer installation. Undersize from the screens, 3 mm in size, is directed to the secondary log washers. Transportation of the sink-float plant feeds from the final washing section to respective treatment units in the sink-float plant is via two incline belt conveyors. The plus 8-mm product is passed over a 1.5x5-m screen unit producing a plus 12-mm oversize material which is directed to the cone separator and a minus 12-mm undersize material which is treated in an impact mill. Discharge from the mill goes to a vibrating screen with deck containing 2-mm openings. Undersize from this screen returns to the primary washers, and the oversize goes via a bucket elevator to a two-section control screen (first section serves as dewatering unit) which produces a plus 8-mm oversize product for the cone separator and a minus 8-mm to 3-mm undersize product for the cyclone separation system. The cone separator is 3-m in diameter and slope of cone 40°. In the cyclone treatment section there are two separate systems, each employing two cyclones operating in parallel (350-60-100-80-20°—1.2 atu). Normally, only one system is in operation. Ferrosilicon is the heavy medium used in both cone and cyclone separation systems. The ferrosilicon used in the cyclone section is finer than that used in the cone separator. In the cyclone section, it is added to the mixer receiving the minus 8-mm to 3-mm material from the final washing department. The mixed product flows by gravity to the two cyclones mentioned. Distance between the mixer overflow level and the cyclone intake is about 4.6-m. Equipment available for washing the separated sink and float products, for circulation and recovery of medium, and layout are more or less standard, as shown in the plant flowsheet. Power requirement of both separator sections is about 3 kwh per ton; water consumption, 1.5-m^3 per ton; and medium loss, 140 g per ton. Nonmagnetic material removed by both systems is 240 tpd. It returns to the primary washers.

Slime Treatment Plant

At a production rate of 22,000 tpd, the tonnage of slimes directed to the

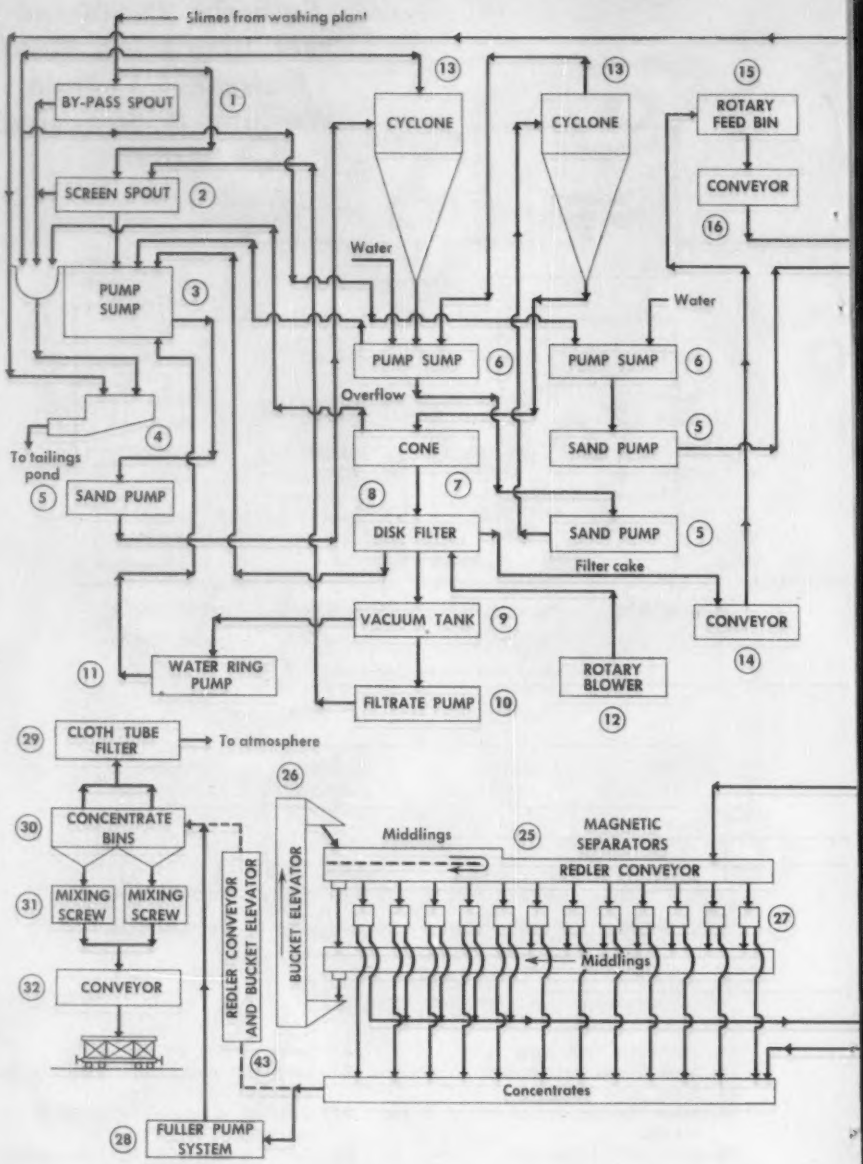
slime treatment plant amounts to some 6,600 tons. The material is minus 0.25-mm in size, has a solids content from 140 to 160 g per l, and assays 16% iron. Principal solids components are iron-bearing clay, quartz, undissolved clay fragments, and very small iron carriers taken up and carried out of the log washers by the overflows. The iron carriers—ooide shells, very small limonite fragments, siderite, and spherosiderite—in general are between 250 and 20 microns. Material below 20 microns contains only clay and quartz. Table 1 gives a typical screen analysis of the slime treated. Prior to 1955 all slime went untreated to the dewatering ponds. Current practice is the result of study, laboratory test and pilot plant work carried on over a period of years.

Treatment of slimes involves three major steps—(1) classification of 20-micron slimes with simultaneous thickening and dewatering of plus 20-micron material; (2) drying the plus 20-micron material; and (3) treatment of the plus 20-micron material in high-tensity magnetic separators. Classification of the slimes is carried out in hydro cyclones. The log washer overflows from the main washing plant are brought to the large pump sump at the head of the cyclones via a launder. From the sump they are pumped direct to 30 hydro cyclones (350-60-50-20-10 deg—2.5 atu). The plus 20-micron cyclone underflow (apex) carry about 1,200 gpl solids or 35% water. In order to reduce the clay in the underflow to a minimum, the solids content is reduced to about 450 gpl by addition of fresh water preparatory to treatment in five secondary hydro cyclones 350-60-70-30-10°—1.0 atu. To save fresh water, a part of the secondary cyclone overflow is used for diluting the primary cyclone underflow. The underflow from the secondary cyclones goes successively to a slime cone and a Wedag disk filter with a total filter area of 40 m². The resultant cake contains from 18 to 19% moisture.

Filter Cake Is Heat-Dried at 800 to 1000° C

Drying of the filter cake is accomplished in a Büttner-Schwebe dryer 1.2 m in diameter and 10 m high. The drying zone is lined with firebrick. Temperature in this zone is maintained at 800° to 1000° C, and that in the exhaust region, 75° to 85° C. The automatic Bremer firing system serving the dryer uses brown coal tar oil for fuel. Filter cake is fed into the dryer by a 30-ton capacity Babcock rotary feed bin and feeder belt served by a belt conveyor 650 mm wide operating between the disk filter and the

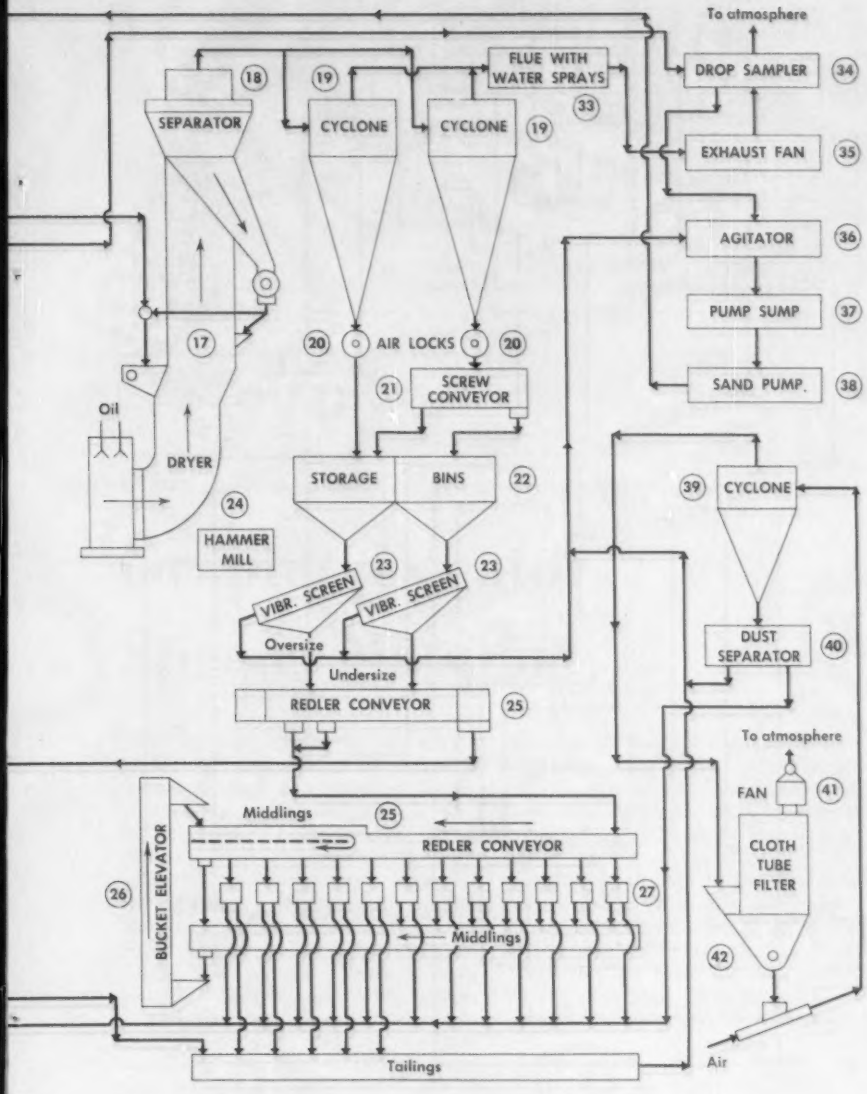
Erzbergbau Salzgitter AG. Calbecht Flowsheet 3



LEGEND

1. By-pass spout
2. Screen spout
3. Pump sump
4. Sump
5. Centrifugal sand pump
6. Pump sumps
7. Settling cone
8. Disk filter
9. Vacuum tank
10. Filtrate pump
11. Water ring pump
12. Rotary blower
13. Wet cyclones (30 primary and 5 secondary)
14. Incline conveyor
15. Babcock rotary feed bin
16. Incline conveyor
17. Büttner-Schwebe dryer 1.2 dia and 10 m high
18. Dust separator
19. Two von Tongeren dry cyclones
20. Two air locks
21. Screw conveyor
22. Dust storage bins
23. Two vibrating screens
24. Hammer mill
25. Redler conveyors
26. Bucket elevators
27. Salzgitter magnetic separators
28. Fuller pneumatic pump system
29. Cloth tube filter
30. Concentrate storage bins
31. Two mixing screws
32. Incline loading conveyor
33. Flue with water sprays
34. Drop sampler
35. Exhaust fan
36. Agitator
37. Pump sump
38. Centrifugal sand pump
39. Dry cyclone
40. Dust separator
41. Fan
42. Cloth tube filter
43. Two Redler conveyors and bucket elevator

22,500-tpd Wet Upgrading Plant
Slime Plant



feeder bin. Dust collecting equipment for treating dryer exhaust gases consists of a special separator unit (Prallsichter) at the top of the dryer and two dry cyclones in parallel, each measuring 2.8 m in diameter. Coarse and still somewhat wet material removed by the separator returns to the dryer. The gases leaving the cyclones carry about 2g/m³ dust. This figure is reduced to 150 mg/m³ after passage through a canal or flue with water sprays installed between the cyclones and the exhaust fan rated at 90,000 m³ per hour.

Four-Fold Separation

The dried cyclone product (0.5% moisture) passes to two vibrating screens (1-mm openings) for removal of foreign matter that may be injurious to the rolls of the high-intensity magnetic separators which produce the final concentrate. Oversize from the screen goes to waste, and undersize is passed to a Redler conveyor 315 mm wide for subsequent transfer to the Redler units serving the two sets of magnetic separators, each made up of 12 units. In view of the weak magnetic nature of the ore treated, a four-fold separation is required. This is accomplished as shown in the accompanying flowsheet. All separators are of Salzgitter design and construction. They are made especially for very fine-grained ore of paramagnetic nature. A new separator has recently been developed which can handle dust, 70% minus 400 mesh, from the dust collecting system described with the same efficiency, feed rate and recovery as the present units in operation treating the 250 to 20 micron size material. The final concentrates assay 33% iron, and tailings 10 to 11% iron. Subsequent sintering at Heerte will bring the iron content of the concentrates up to about 39%. Two Redlers and one bucket elevator available in the plant transfer the fin-

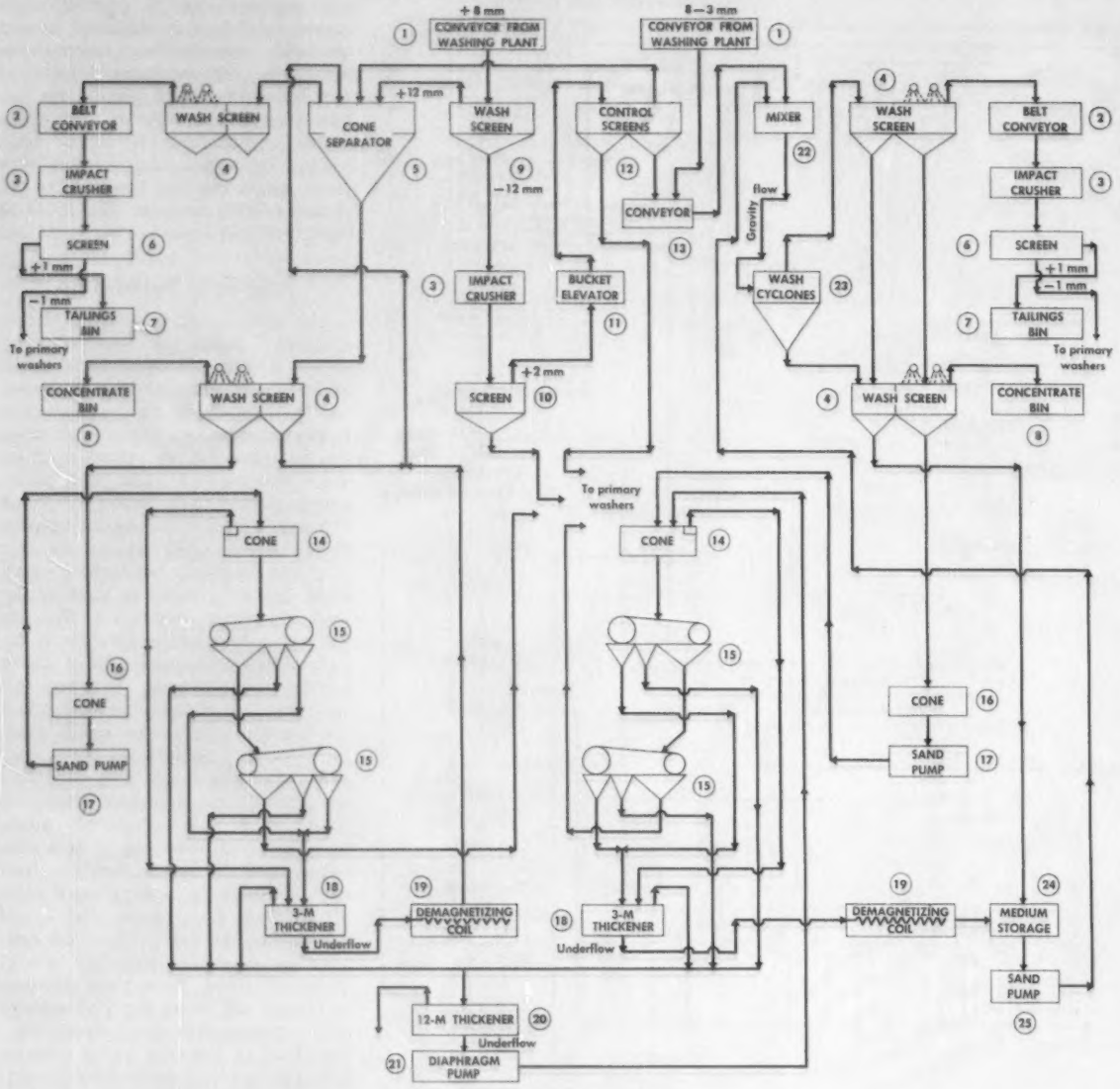
Table 1. Screen Analysis of Slime Plant Feed

Size, mm	% Weight	% Fe
0.20	6.4	27.2
0.20 –0.15	3.5	26.1
0.15 –0.10	4.0	25.3
0.10 –0.075	1.4	24.0
0.075–0.060	1.3	22.1
0.060–0.040	2.7	17.7
0.040–0.034	3.0	18.5
0.034–0.020	2.7	15.0
0.020	75.0	12.5
	100.0	15.1

Table 2. Operational Data Covering Slime Plant

Cyclone Section	% Weight	% Fe	Fe x weight	% Recovery
Slimes	100.0	15.1	15.1	100.0
Cyclone overflow	70.0	12.0	8.4	55.6
Cyclone underflow	12.5	17.3	2.2	14.6
Cyclone 2 underflow and dust loss	17.5	25.7	4.5	29.8
Magnetic Separator Section				
Cyclone underflow	100.0	25.7	25.7	100.0
Concentrate	67.6	32.9	22.2	86.4
Tailings	32.4	10.8	3.5	13.6

Erzbergbau Salzgitter AG, Calbecht 22,500-tpd Wet Upgrading Plant
Flowsheet 2—Sink-Float Plant

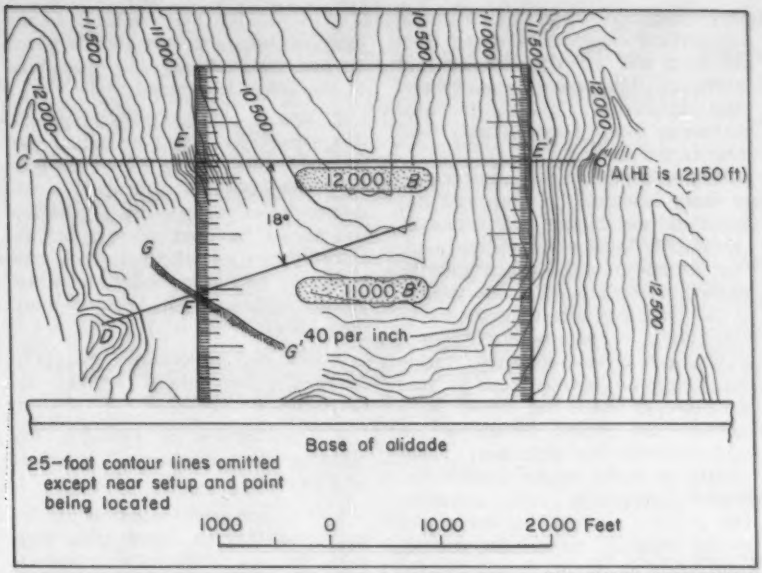


LEGEND

1. Two belt conveyors from washing plant
2. Belt conveyor
3. Four impact mills
4. Three float wash screens and three sink wash screens
5. 3-m cone separator vessel
6. Screen
7. Tailings bin
8. Concentrate bin
9. Primary wash screen
10. Screen
11. Bucket elevator
12. Control screens
13. Conveyor
14. Two settling cones
15. Ten magnetic separators
16. Two settling cones
17. Two centrifugal sand pumps
18. Two 3-m thickeners
19. Two demagnetizing coils
20. 12-m thickener
21. Diaphragm pump
22. Mixer
23. Two cyclones in parallel
24. Heavy medium storage
25. Centrifugal sand pump

ished concentrates to the storage bin. Operational plant data are given in Table 2.

The entire plant described covers an area of about 60,000 m², and all buildings are steel-frame structures with brick facing. Operations are carried on in three shifts. Total number of men employed averages 350 and that of supervisory personnel 23. Over-all metal recovery is 82.5%. Power consumption amounts to 6.4 kwh per ton and water about 2.0 m³ per ton. Steel consumption on the AP5 impact mill and on primary and secondary crushers averages 2 g per ton while that on the SAP4 impact mills is 15 g per ton. Life of pump parts varies according to the type of material handled. Slime pumps average 3600 hours, and those handling heavy medium and that recovered by wash screens 2200 and 4965 hours respectively. A wash cyclone handles 120,000 tons during its life. The tailings ponds in operation today can store some 30-million m³ of plant tailings.



From U.S.G.S. Bulletin 1081-A

SIMPLE plastic device helps locate line of sight intersections on maps.

Graphic Locator Speeds Mapping

THE GRAPHIC LOCATOR—a simple plastic device developed by David J. Varnes of the U.S. Geological Survey—is used with a topographic map and the telescopic alidade or other sighting instrument to determine the point at which the line of sight intersects the ground. It may be used to plot features of interest which are identifiable from an observation point of known location and elevation. Field tests show that the use of the graphic locator can greatly speed routine geologic mappings in areas of moderate relief and can furnish reliable locations for points in cliffs that cannot be examined on foot.

According to David J. Varnes, Tommy L. Finnell and Edwin V. Post in U.S. Geological Survey BULLETIN 1081-A, "Graphic-Locator Method in Geologic Mapping", the simple device has been proven in the field and is used in the following manner.

The graphic locator consists of a single rectangle of transparent plastic material, about 3 in. sq and one-sixteenth in. thick.

Two scales, graduated in divisions corresponding to the contour interval of the topographic map with which it is to be used, are marked or engraved on the underside of the rectangle, one at the right and one at the left edge. The space between the divisions represents one contour interval or convenient multiple thereof. The distance between graduations is the linear distance that equals the contour interval at the scale of the map. The drawing shows the use of the graphic locator in mapping an area in the San Juan region, Colo., on a topographic map having a contour interval of 25 ft and a horizontal scale of 1 inch-1,000 ft. The scale divisions on the model, computed from the equation (below) are one-fortieth inch apart.

$$25 \times 12 \frac{1}{1{,}000 \times 12} = 1/40 \text{ in.}$$

The etched areas B and B′, in the drawing between the major scale divisions, are used for recording with pencil the range of elevations for any particular setup.

Because of the simplicity of its construction, sets of the graphic locators can readily be made for use with maps having any specified contour interval or horizontal scale.

The procedure for using the graphic locator is as follows:

1. Location of the planetable setup point A is plotted on the topographic map by resection or other suitable means.

2. Elevation of the alidade (or height of instrument, HI) is determined by vertical angle measurements or other means to be 12,150 ft.

3. Reference elevations are written in the opaque area B and B′ on the graphic locator, assuming that the range in elevations for the shot used in this example will be between 10,000 and 13,000 ft.

4. The telescopic alidade is sighted at the point to be plotted; ray A-C is drawn on map and the vertical angle read. If an open-sight alidade is used, the line of sight is drawn and the angle is read with a Brunton compass.

5. From the ray A-C the vertical angle CAD is plotted with an 8-in. protractor and a segment of the line A-D drawn. In the example, the angle is minus 18°.

6. The graphic locator is placed over the ray A-C so that the scale readings at both edges (E and E′) correspond to the HI of the instrument (12,150 ft). While held firmly in this position, the straight edge of the alidade base is placed against either the top or bottom edge to serve as a guide for shifting the graphic locator laterally.

7. The locator is then shifted along the straight edge until the edge of the scale at E intersects line A-C at the estimated position on the map of the point being shot.

8. Next, it is noted whether the scale reading at F (the point where line A-D crosses the edge of the scale) is greater or less than the contour reading at E. If, for example, the contour elevations of the estimated position at E is 10,900 ft, the scale reading at F would be about 10,975 ft. This means that the line of sight has not yet intersected the ground surface at point E. A profile of the ground surface, G-G′, has been added to the drawing to indicate the relation of the ground surface to the line of sight.

9. If the graphic locator is moved farther to the left so that the contour reading at E is 11,000 ft, then the scale reading at F will read about 10,930 ft, meaning that the line of sight has penetrated the surface and the point is located by this second estimate lies beneath the ground surface. The point sought must, therefore, lie between the 10,900- and 11,000-ft contour lines on A-C. The range between the trial points is then quickly reduced by moving the graphic locator back and forth between the 10,900- and 11,000-ft contour lines.

10. When the position of the graphic locator is such that the contour elevation at E is the same as the scale reading at F (10,950 ft in the example) the point of intersection at E is the point on the map that is sought.

The method of using the locator may be reversed. In this procedure,

the geologist walking a contact on the side of a hill may take bearings and vertical angles with his Brunton compass to a point of known location and elevation shown on the topographic map. The known point is then used as a "setup" and the usual procedure is followed to determine the location of the observation. If bearings and vertical angles are taken to several known points from the geologist's position, the locator technique may be combined with, and checked by, the standard method of location by resection.

The degree of accuracy with which points may be determined with the graphic locator depends upon the accuracy of the topographic map, upon the accuracy of manipulation of the instrument, and upon the relief of the terrain.

To evaluate the combined errors that may be inherent in the construction and manipulation of the graphic locator, a number of "shots" were taken between points on a topographic map whose position and elevation had previously been determined by topographers. The contour map was therefore very accurate in the immediate vicinity of the known points and any error in relocating the points by the process described above would be inherent either in the instrument, the procedure, or a combination of both. The test was carried out in the office on 32 known points. Angles were computed from the horizontal and vertical distances as scaled from the map and plotted with an 8-in protractor. The operation was thereafter completed in exactly the same manner as would normally have been done in the field.

It was found that the major source of error between the measured distance and distance as determined by the graphic locator lies in the angle that the line of sight makes with the surface of the ground in the vicinity of the point that is being located. The distribution of points plotted on a graph shows that a low angles (grazing shots) large errors may occur because the point at which the line of sight intersects the ground surface is generally difficult to determine. Conversely, at higher angles location becomes increasingly more accurate. The graphed showed that for angles greater than 25° to 30° the error is consistently less than 1% and that for angles greater than 15° the mean error is less than 1%. Thus, the graphic locator cannot be used effectively in the line of sight makes an angle of less than 15° with the surface of the ground in the vicinity of the point being located.

Although the absolute error in feet may tend to increase with length of shots, owing to possible errors in plotting the vertical angle, the percentage error showed no definite relation to the over-all length of shot.

1. A location may be fixed within three minutes after the alidade is set up and the position and evaluation of the setup determined.

2. Results obtained with the graphic locator, as checked by actual rod determinations in the course of geologic mapping, are sufficiently accurate for most geologic use. Where the rod cannot be used, the graphic locator offers a reliable alternative, provided the line of sight intersects the ground surface at an angle of more than about 15°.

3. The graphic locator is especially suited for long shots, beyond the range of the rod.

4. The locator is valuable for checking the accuracy of questionable rod shots.

5. The instrument is useful for determining from a topographic map alone the area visible from any selected point.

6. Use of the graphic locator results in a great saving of time in mapping rough terrain because the number of rod shots required is reduced. The services of a rodman are not required for location of features that may be identified by the instrument man. If the outcrop requires examination, the geologist on the outcrop need not carry a rod but simply signal for a shot to be taken on himself.

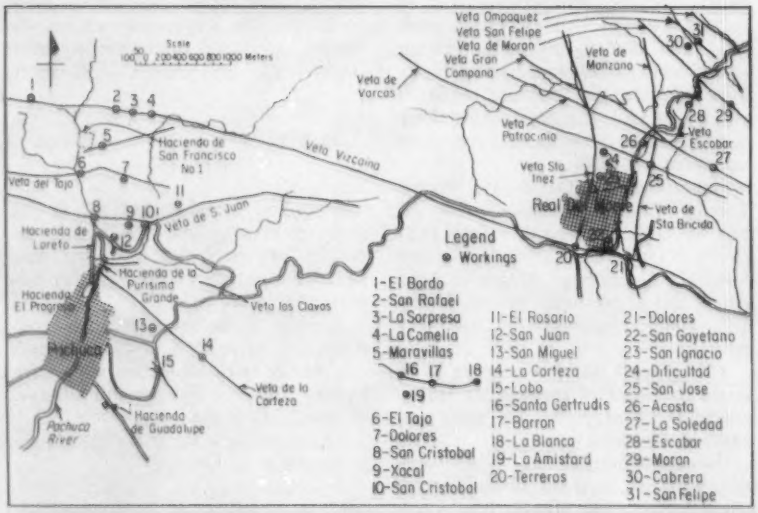
Abstracted from U.S.G.S. Bulletin 1081-A.

Mexico To Treat Pachuca Tailings

AFTER MANY YEARS of diligent research, the Mexican government has developed a process—simple sulphide flotation—for recovering a considerable portion of the silver, gold and lead remaining in the millions of tons of cyanide tailings piled around the city of Pachuca. The economics of the process are in question—the flotation plant feed contains only 25c worth of values. At any rate, the plant will provide jobs for a few workers in the steadily declining mining district which was once the world's top silver producer and which gave its name to the Pachuca tank, formerly known as the Brown Agitator.

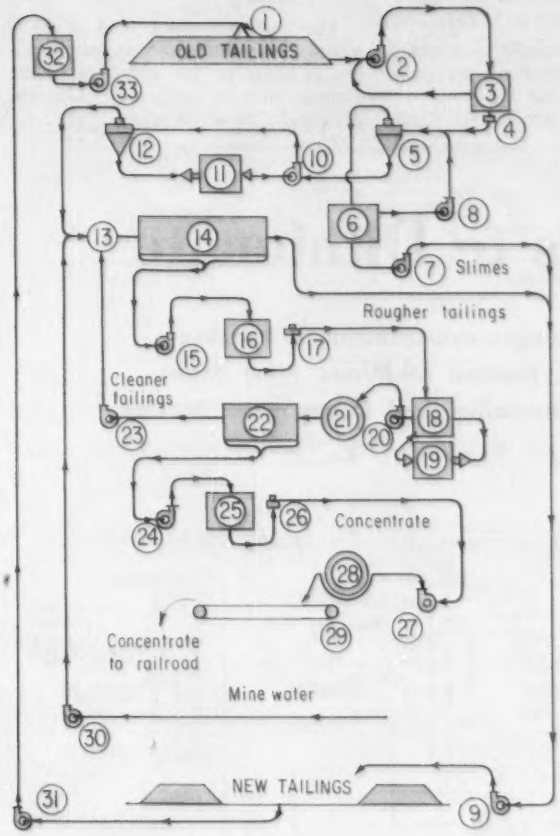
Back in 1947, Cia. Real del Monte y Pachuca was taken over by the Mexican government "for economic reasons." The company, U.S. owned, was having financial difficulties and needed more government subsidy, threatened to shut down if the petition went unheeded.

The Mexican government said it couldn't raise the subsidy, but it



THESE thirty-odd mines produced millions of oz of silver and millions of tons of tailings in the Pachuca-Real del Monte area over the ages since silver was discovered there. Map is redrawn from that presented by Charles T. Rice in his article "Pachuca and Real del Monte Silver District," pp 519-25, Sept. 12, 1908, E&MJ.

Silver Tailings Reclamation, Cia. Real del Monte y Pachuca Pachuca, Mexico



LEGEND

1. Six to eight hydraulic monitors sluice ore to the mill
2. Four Denver Equipment Co. 10x8-in. SRL sand pumps
3. Denver 15-ft dia agitator tank
4. Ohmart gamma ray, Foxboro controls and Minneapolis-Honeywell regulators control tonnage and density
5. Nine Krebs D-20-B cyclones
6. Two Door 150-ft dia thickeners
7. Two Denver 10x8-in. SRL sand pumps (Ampli-Speed regulation)
8. Ingersoll-Rand 1700-gpm pump and one Dayton-Dow 14x12-in. (3,000 gpm) pump
9. Three Denver 10x8-in. SRL sand pumps
10. Three Denver 10x8-in. SRL sand pumps (Ampli-Speed controls)
11. Marcy grate mill No 77½
12. Six Krebs D-20-B cyclones
13. Three 12x12-ft tanks
14. Three banks of twelve cells each, Denver Sub-A No. 30, 56-in. machines.
15. Denver 5x4-in. SRL sand pump
16. Denver thickener 40-ft dia and 12-ft depth
17. Denver 3-in. diaphragm pump
18. Dorr rake classifier, 21 ft 8 in. x 6 ft
19. Denver 5x10-ft ball mill, trunnion discharge
20. Two Denver 2x2-in. SRL sand pumps
21. Denver 8x8-ft conditioner
22. Four cleaner flotation machines, Denver No. 21 Sub-A, 38-in machines
23. Denver 3x3-in. SRL sand pump
24. Denver 2x2-in. SRL sand pump
25. Dorr thickener 40-ft dia and 12 ft depth
26. Denver Simplex 4-in. diaphragm pump
27. Denver 2x2-in. SRL sand pump
28. Eimco four-disk filter with 8-ft 10-in. dia leaves
29. Conveyor belt, 20 in. wide and 120 ft long
30. Ingersoll-Rand No. 8 CFV 10x8-in. pump
31. Dayton-Dow 14x12-in. pump
32. Head tank to hold water for the monitors, 38 ft 7½ in. dia and 16 ft depth
33. Two Ingersoll-Rand Type 6 GT 1600-gpm (250-hp) pumps

bought the mine to avoid part of a city (population 60,000) being permanently unemployed.

Pachuca is a mountain mining town distinguished by artificial mountains of tailings from spent or near spent silver mines. The population has increased but jobs have decreased.

Faced with the situation, the Mexican government embarked on a research program to try to get something out of the millions of tons of cyanide process tailings piled up around the town.

For years now, work has been going on at a 100-tpd pilot plant in Pachuca. But, not until 1959 had the government been able to get moving on its plan to reclaim the extremely low-grade silver tailings.

Late in August, the Mexican government quietly started up a much bigger plant, an installation which cost more than $1-million, to further test the new process. The process is working smoothly, mining officials claim, and the new plant will be officially inagurated in late October or November.

The whole operation is being run by the Comision de Fomento Minero (Mining Development Commission) of the Mexican government. Officials claim the reclamation plant is the only one of its kind in this Hemisphere and perhaps the only one of its kind in the world.

The plant will take the low-grade tailings, previously thought uneconomical to work, and extract some 25c worth of silver, gold and lead from each ton of the tailings. There are approximately 50-million tons of tailings in one deposit being worked, officials said; the government's possible income will be around $12.5-million.

But the main thing the plant will do is bring new life back into an ailing community. If the plant works economically in the long run, the government will install many other plants in Pachuca and around Mexico in its own mines, and will encourage the big, private mining companies to take up the system to rework other low-grade tailings. "There are literally billions of tons of the tailings spread all over Mexico, many dating back to early Spanish conquest days," one government official explained.

The Pachuca plant uses monitors to loosen the tailings and send them down through wooden launders and metal pipes to the plant site.

Oswaldo Gurria Urgell, director general of Fomento Minero and manager of the Real del Monte, mine told E&MJ that this completely new arrangement of an old reclamation system was developed by Russell R. Bryan, consulting engineer of San Francisco, who has been associated with the Real del Monte for many years.

The plant capacity is 7,500 tpd, but by the end of the year production will be upped to 10,000 tpd, Urgell said. These particular tailings date back to the turn of the century, he explained.

The common chemicals for sulphide flotation are being used—sulphuric acid, xanthates, frothers etc. Cyanide was used in the original silver extraction process and cyanide compounds remaining in the tailings make for the necessity of extremely careful

handling. Otherwise, Pachuca might be flooded with deadly cyanide gas.

The Mexican government, in figuring whether the plant would be economical or not, took into consideration the fact that the iron concentrates produced from the flotation process would be consumed by local Mexican foundries. Also, the government figured that the price of silver (90c/oz) wouldn't go down much, if at all.

The analysis of the deposits averages out per ton to:

Ag—47.6 g; Au—0.16 g; Pb—less than 0.1%; Zn—around 0.2%; Fe—approximately 2.0%.

The six major steps in the entire operation from deposit to storage are:

1. Mining by hydraulic monitors.
2. Electronic control of the pulp density grade and ton.
3. Separation of sands and slime and recovery of monitor water.
4. Rougher flotation of the sands.
5. Cleaner flotation of rougher concentrate.
6. Rewatering and disposal of new tailings.

The Pachuca plant feed is 58% minus 200 mesh and contains the silver as silver in the sulphides, in the gangue, and in refractory minerals, principally those of manganese.

Manganese Responds to Dithionate

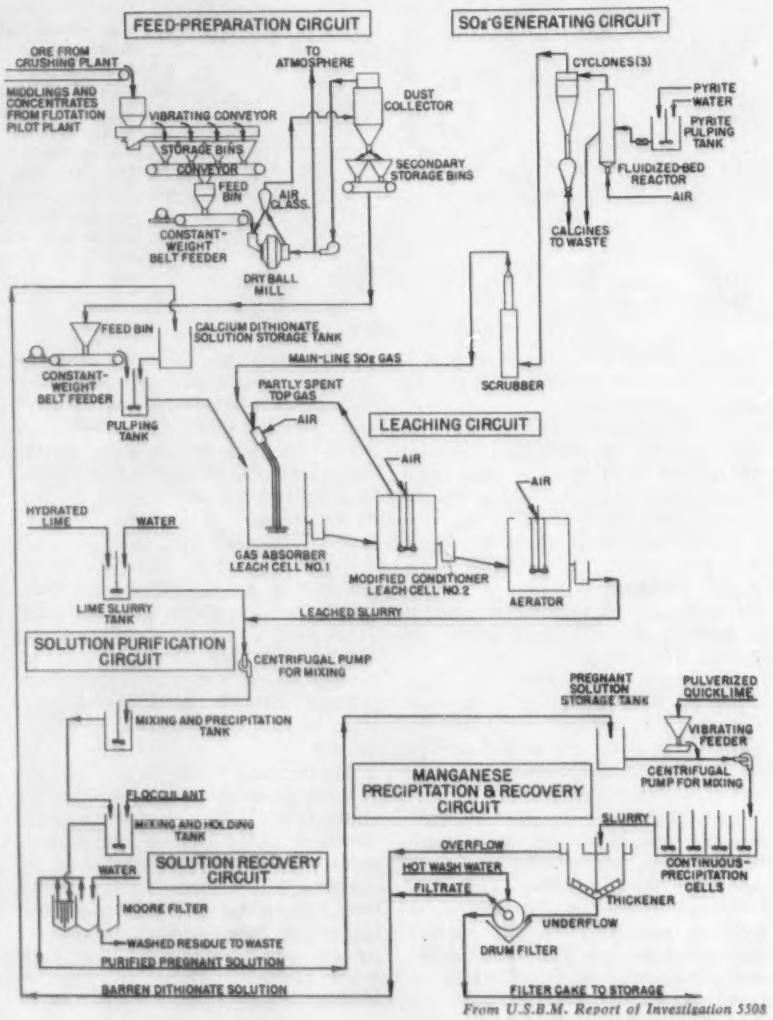
Manganese-Dithionate Process
U.S. Bureau of Mines Pilot Plant
Electrometallurgical Experiment Station
Boulder City, Nev.

THE ARTILLERY MOUNTAINS of Arizona hold an estimated 175-million tons of low-grade manganese ore assaying 3 to 4% Mn. Field work by the U.S. Bureau of Mines and private mining companies have proved 6.25-million tons of 7.9% Mn in claim blocks, with one group containing 2-million tons of 10.6% Mn material. However, the ore does not respond to any normal upgrading means to yield a product suitable for ferromanganese production. Flotation was tried but it failed. Finally, the Bureau of Mines tried and proved the Dithionate Process which yields a high-purity manganese hydroxide as the end-product.

In a pilot plant operated from May 1951 to October 1953, the Bureau produced by the Dithionate Process about 1400 lb per day of manganese hydroxide (55 to 60% Mn) with 89% recovery when using Maggie Canyon ore; 93% when using flotation middlings; 96% on flotation concentrate. Preliminary studies of the flowsheet shown here by the Bureau estimate the cost of 1,000-tpd ore feed Dithionate Process plant at $8-million (not including auxiliaries). Direct operating cost of such a plant have been estimated at $1 per long ton unit.

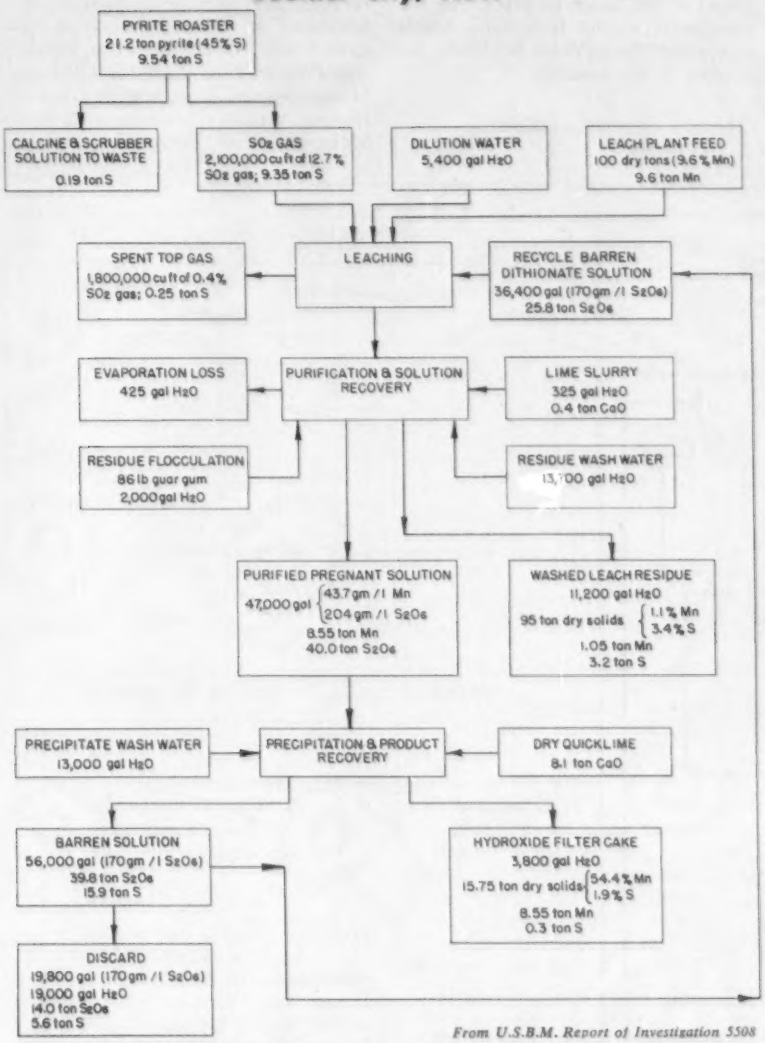
In the Dithionate Process, finely ground manganese oxide ore is suspended in a solution of calcium dithionate and leached by agitation in tanks, with sulphur dioxide as the solvent. Dissolution of the manganese oxides results in formation of a mixture of manganese dithionate and sulphate. In the presence of calcium dithionate, the manganese sulphate is converted to manganese dithionate, while calcium sulphate is simultaneously precipitated in the pulp. The pregnant solution is separated from the leached residue, and the manganese precipitated as the hydroxide by the addition of quicklime. Calcium dithionate is regenerated during the precipitation step and subsequently is recycled to the leach operation.

The ore, middlings, and concen-



From U.S.B.M. Report of Investigation 5508

Manganese-Dithionate Material Balance
U.S. Bureau of Mines Pilot Plant
Electrometallurgical Experiment Station
Boulder City, Nev.



From U.S.B.M. Report of Investigation 5508

trates processed by the Bureau at Boulder City, Nev. assayed 9.6, 15.2, and 32.9% Mn, respectively. The sulphur dioxide used for leaching was made by roasting pyrite flotation concentrate containing 45% sulphur in a fluidized-bed reactor. A roaster gas containing up to 13% SO by volume was produced without difficulty. About 2 lb of sulphur dioxide was consumed per lb of manganese recovered from the ore, middlings, or concentrations.

Several types of leach cells were tested during the investigation. A circuit consisting of two rubber-lined tanks equipped with agitator-aerator assemblies for contacting the ore and gas gave the best results. The agitators were designed to inspirate the gas and bring it into intimate contact with the ore particles.

After leaching, the pulps were aerated in a third cell to convert unreacted sulphur dioxide to sulphate to prevent precipitation of manganese sulphites in the subsequent solution-purification step. The aerated pulp was neutralized to a pH about 5.5 by adding lime slurry to precipitate iron, alumina, phosphorus, silica, and other dissolved impurities. Slightly less than 1% of the dissolved manganese was lost by precipitation in the purification step.

Several methods of separating the purified pregnant leach solutions from the leach residues were investigated. Best results were obtained by flocculating the leach residues with guar gum for filtration and washing them on a Moore-type vacuum leaf filter.

The manganese was precipitated from the purified pregnant leach liquor by feeding the solution and dry, pulverized quicklime into a centrifugal pump and then agitating the slurry in a series of modified flotation cells to insure complete reaction. About 1 lb of available CaO was required to precipitate 1 lb of manganese as the hydroxide. The slurry, which contained 4 to 5% solids, was thickened continuously to obtain an underflow of 23% solids. The thickened precipitate was heated to about 60° C., filtered and washed with hot water on a continuous drum filter. The washed and dried filter cake assayed 55 to 60% Mn regardless of the feed material.

In the Dithionate Process, finely ground manganese ore is suspended in calcium dithionate (CaS_2O_6) solution and leached by agitation with dilute sulphur dioxide gas. The manganese dioxide is dissolved as manganous dithionate and sulphate with the formation of some sulphuric acid according to the following reactions:

$$MnO_2+SO_2\rightarrow MnSO_4$$
$$MnO_2+2SO_2\rightarrow MnS_2O_6$$
$$H_2O+SO_2+\tfrac{1}{2}O_2\ (\text{Mn catalyst})\rightarrow H_2SO_4\ (\text{Mn catalyst})$$

When the ore contains a lower oxide, such as MnO, the manganese is dissolved according to the following reaction:

$$MnO+H_2SO_4\rightarrow MnSO_4+H_2O$$

The lower oxide also may react directly with sulphur dioxide and oxygen in the aqueous medium to give the sulphate in accordance with the reaction:

$$MnO+SO_2+\tfrac{1}{2}O_2\ (\text{aqueous})\rightarrow MnSO_4$$

Intermediate oxides, such as Mn_2O_3 and Mn_3O_4, are leached by a combination of sulphur dioxide and sulphuric acid to form sulphate or mixtures of sulphate and dithionate by the following reactions:

$$Mn_2O_3+H_2SO_4+SO_2\rightarrow 2MnSO_4+H_2O$$
$$Mn_2O_3+H_2SO_4+2SO_2\rightarrow MnSO_4+MnS_2O_6+H_2O$$
$$Mn_3O_4+2H_2SO_4+SO_2\rightarrow 3MnSO_4+2H_2O$$
$$Mn_3O_4+H_2SO_4+2SO_2\rightarrow 2MnSO_4+MnS_2O_6+2H_2O$$

In the presence of excess calcium dithionate, the sulphates formed during leaching are precipitated in the pulp as calcium sulphate, with formation of manganese dithionate and dithionic acid.

$$MnSO_4+CaS_2O_6\rightarrow MnS_2O_6+CaSO_4$$
$$H_2SO_4+CaS_2O_6\rightarrow H_2S_2O_6+CaSO_4$$

Dissolved lead and barium also precipitate from the solution as sulphates, but any copper and zinc present are soluble in the leach solution and must be removed by precipitation with lime before recovering the manganese.

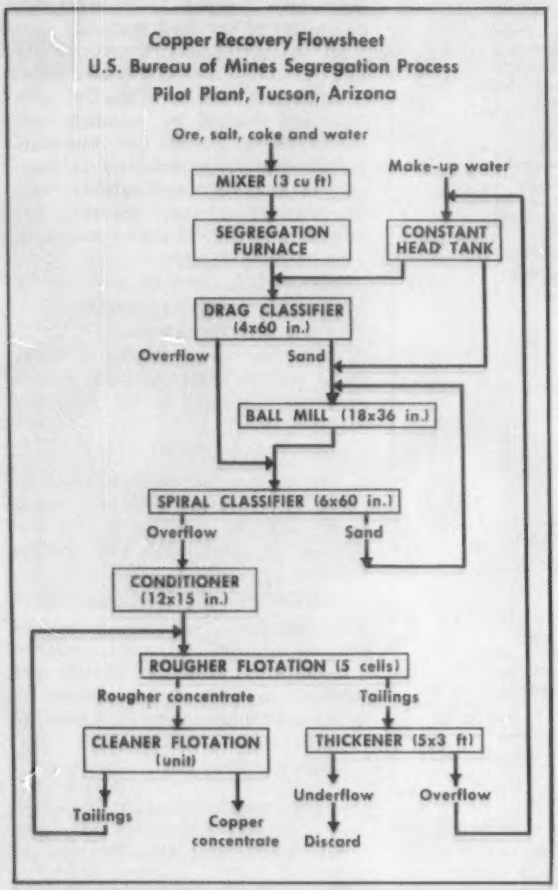
The leach pulp is aerated to oxidize ferrous iron to the ferric state and to remove or oxidize excess sulphur di-

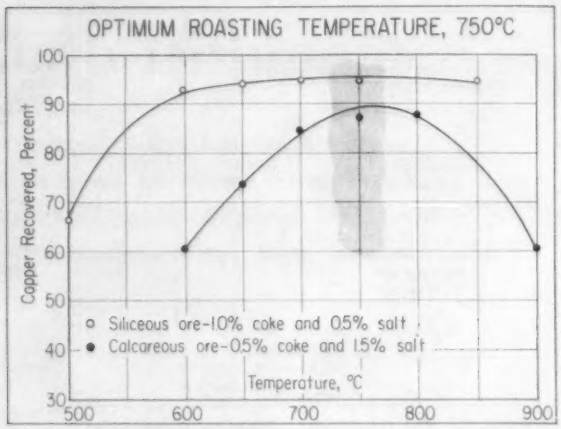
oxide and sulphates that would interfere with the subsequent lime-purification step. Some additional acid is formed by catalytic oxidation of SO_2 during the aeration step. The quantity of acid formed is usually adequate to dissolve any residual manganeous oxide in the leach pulp by reaction.

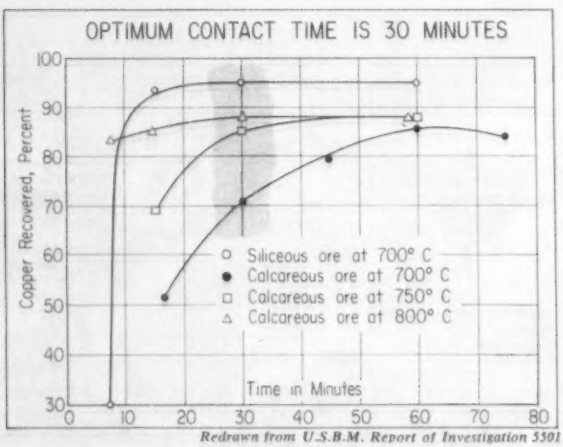
After aeration, the pulp, which has a pH of 1.5 to 3.5, is neutralized to a pH of about 5.5 by adding a hydrated-lime slurry to precipitate alumina, silica, iron, phosphorus, zinc, and other dissolved impurities. The partly neutralized pulp then is filtered, and the cake is washed to recover purified pregnant liquor. Quicklime then is added to the liquor to precipitate the manganese as the hydroxide, which regenerates the calcium dithionate according to the reaction:

$$MnS_2O_6 + Ca(OH)_2 \rightarrow Mn(OH)_2 + CaS_2O_6$$

The manganese hydroxide precipitate is filtered, washed, and dried and then is sintered or nodulized to give a ferrograde product assaying 63 to 66% Mn. The calcium dithionate is recycled for leaching additional ore, according to REPORT OF INVESTIGATION 5508, "Operation of a Dithionate-Process Pilot Plant for Leaching Manganese Ore from Maggie Canyon Deposit, Artillery Mountains Region, Mohave County, Arizona".




OPTIMUM ROASTING TEMPERATURE, 750°C
Copper Recovered, Percent
Siliceous ore-10% coke and 0.5% salt
Calcareous ore-0.5% coke and 1.5% salt
Temperature, °C


OPTIMUM CONTACT TIME IS 30 MINUTES
Copper Recovered, Percent
Siliceous ore at 700° C
Calcareous ore at 700° C
Calcareous ore at 750° C
Calcareous ore at 800° C
Time in Minutes

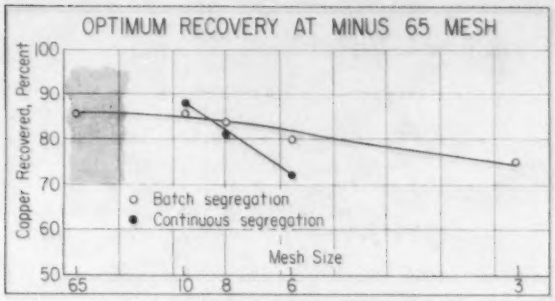
Redrawn from U.S.B.M. Report of Investigation 5501

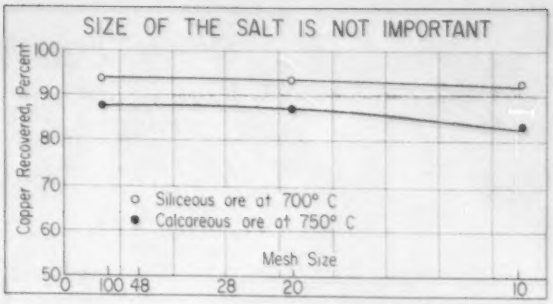
USBM Charts Segregation Process

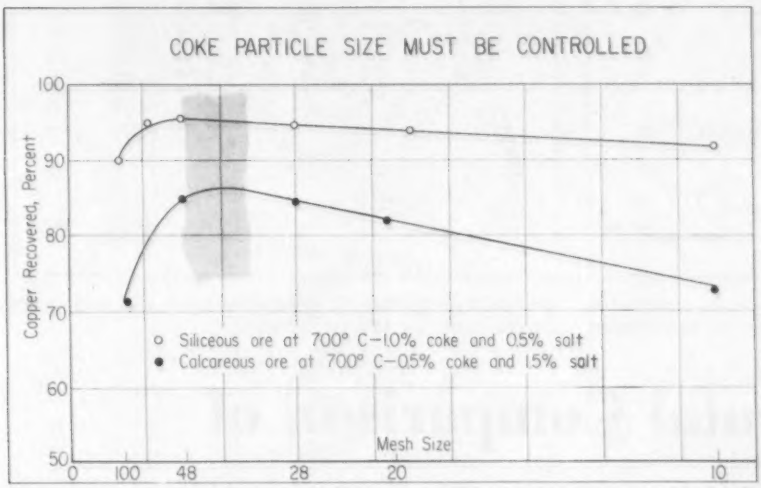
EXTENSIVE BENCH and pilot runs of the old Mineral Separations Ltd.'s Segregation Process show that domestic low-grade ores can be made to respond successfuliy. Scale-up by the Bureau of Mines researchers who did the work suggests that a 1,000-tpd furnacing and flotation operation could treat a mixed oxide-sulphide or a straight oxide ore for $2.85 to $3 a ton, depending on whether coal (lower cost) or coke is used for the reduction.

On a 1% Cu ore at 88% recovery, the cost per pound would be about 16c in a concentrate containing about 26% Cu. This is too high, since straight oxide or sulphide can be floated and smelted for 5 to 7c per lb in a large-scale, 25,000-tpd plant (according to Arbiter in "Oxidized Copper, Part III", March 1957). However, on 5% Cu ores at the same recovery, the concentrate producing cost would drop to the 2- to 3-c per lb range.

The Bureau of Mines work was reported by Carl Rampecek, W. A. McKinney and P. T. Waddleton in REPORT OF INVESTIGATION 5501, "Treating Oxidized and Mixed Oxide-Sulphide Copper Ores by the Segregation Process". The authors, at the







Redrawn from U.S.B.M. Report of Investigation 5501

Bureau's Tucson center, have done an excellent job in recording and reporting the behavior of some of the more important process variables as shown in the diagrams presented here.

Estimating the Cost

The Bureau men estimate crushing, grinding and flotation costs at $1.35 a ton and roasting or segregation costs at $1.50 to $1.65 per ton at 1,000-tpd. Depending on how the roast was ground, recoveries ranged from 70 to 92.4%. Process tailings ran from 0.28 to 0.77% Cu. The Bureau suggests 2.5-million Btu ton as a rough heat requirement figure. Salt content by weight is 1 to 2%; coke or coal needs are ½ to 1%. In the continuous pilot plant experiments, the ore samples were ground minus 100 mesh (76 to 83% minus 200 mesh). Two runs had feed assays of 1.52% and 2.4% Cu and produced 27.1% and 26.15% Cu concentrates respectively on 88.2% and 87% Cu recoveries after segregation and flotation. Flotation reagents were lime, K-amyl xanthate, Reagent 404 and methylisobuytl carbinol. Silver and gold recoveries in the second run were about 35%.

The copper segregation process involves heating oxide ore with a carbonaceous reducing agent and a chloride at 700 to 800° C to produce metallic copper which can be leached with ammonia-ammonium carbonate or floated with sulphide collectors. Such a concentrate must be refined by electrolysis and/or smelting—it is not a marketable product as such.

The first indications of such a process were uncovered at Sagasca, Chile in 1923-1924 when an ore was roasted at 700° C with coal, and the copper reduced and segregated rather than simply reduced in place. Examination of the ore led to the conclusion that halide in the ore was responsible for the peculiar behavior and the Segregation Process, better known as the Mineral Separations Process, was born.

Tried and Proved

The process was tried twice in Africa in the 1920's. Mineral Separations built a plant in Southern Rhodesia. Union Miniere de Haut Katanga built one in the Congo. These two were successful, producing copper concentrates on better than 85% recovery. After short plant runs, the plants were closed due to a variety of reasons—mechanical problems, process irregularities and economics. Other methods were in vogue at the time and segregation died out.

The process essentially is one involving the reaction of a chloride with water and clays in the ore at 700 to 800° C to produce HCl which then reacts with the oxides:

$$4NaCl + Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O \longrightarrow 4HCl\uparrow + Na_4Al_2O_3 \cdot 2SiO_3$$

$$CuO + 2HCl \longrightarrow CuCl_2\uparrow + H_2O\uparrow$$

$$2CuO + 4HCl \longrightarrow Cu_2Cl_2 + 2H_2O + Cl_2\uparrow$$

$$2CuSiO_3 \cdot 2H_2O + 4HCl \longrightarrow Cu_2Cl_2 + 6H_2O\uparrow + Cl_2\uparrow + SiO_2$$

$$2CuSiO_3 \cdot 2H_2O + Cl_2 \longrightarrow Cu_2Cl_2 + 4H_2O\uparrow + 2SiO_2 + O_2\uparrow$$

The chloride may also be provided as chlorine or hydrogen chloride gas with equal success. After the chloride is formed, the reducing atmosphere provided by the carbonaceous material at the 700 to 800° C reaction temperature completes the reaction, producing kidney-shaped globules of copper, carbon and gangue. Many reactions are involved:

$$C + H_2O \longrightarrow CO\uparrow + H_2\uparrow$$

$$CuCl_2 + H_2O \longrightarrow CuO + 2HCl\uparrow$$

$$Cu_2Cl_2 + H_2O \longrightarrow Cu_2O + 2HCl\uparrow$$

$$CuO + CO \longrightarrow Cu^\circ + CO_2\uparrow$$

$$CuO + H_2 \longrightarrow Cu^\circ + H_2O\uparrow$$

$$Cu_2O + CO \longrightarrow 2Cu^\circ + CO_2\uparrow$$

$$CO_2 + C \longrightarrow 2CO\uparrow$$

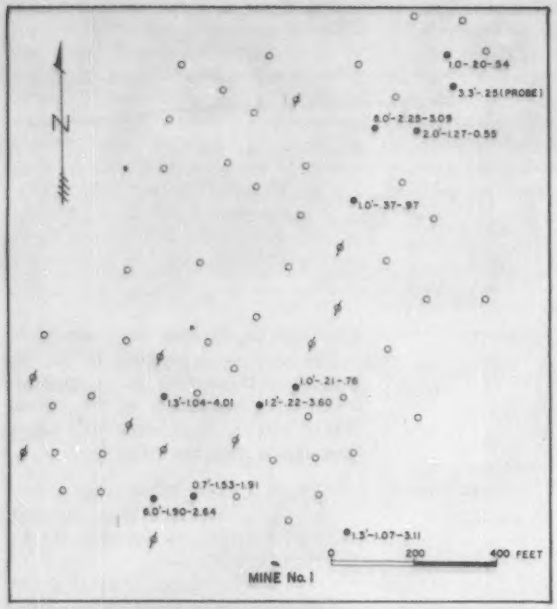
$$Cu_2Cl_2 + C + H_2O \longrightarrow 2Cu^\circ + 2HCl\uparrow + CO\uparrow$$

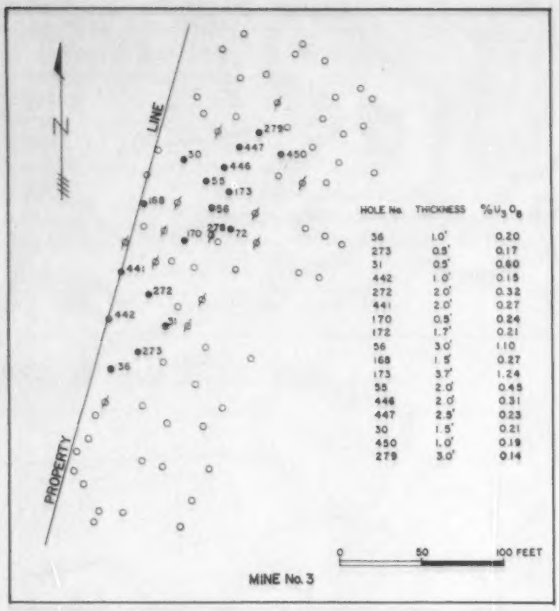
$$2Cu_2Cl_2 + C + 2H_2O \longrightarrow 4Cu^\circ + 4HCl\uparrow + CO_2\uparrow$$

$$CuCl_2 + C + H_2O \longrightarrow Cu^\circ + 2HCl\uparrow + CO\uparrow$$

$$2CuCl_2 + C + 2H_2O \longrightarrow 2Cu^\circ + 4HCl\uparrow + CO_2\uparrow$$

Segregation is never complete and some copper is reduced in place as small particles which would require extra fine grinding to liberate for flotation. The globules are minus 65-mesh particles, fragile and easily broken on a vibrating screen. Flotation recovers the concentrate for smelting-refining. The Bureau is to be congratulated for their efforts, for the data presented here, for reviving interest in a process that may enjoy a revival in a time of high demand for copper buoyed by modern techniques and sound mechanical equipment.





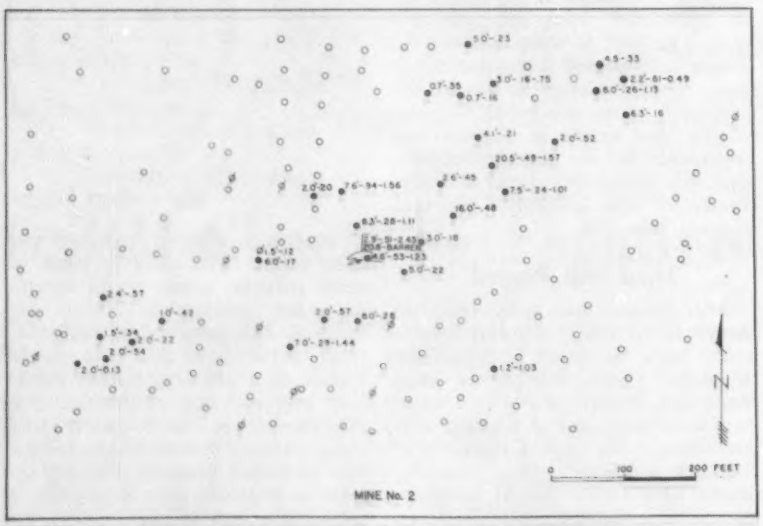
SYMBOLS USED on the five mine drilling maps presented in this article signify the following: Open circles are barren holes; open circles with lines are mineralized holes; and solid circles are ore holes. See text for description.

An Experimental Comparison of U_3O_8 Ore Estimates vs Production

ROBERT J. WRIGHT

IN EXPLORATION FOR URANIUM DEPOSITS in the Salt Wash sandstone of the Morrison formation, the problems of finding ore may sometimes be matched by the difficulty of making reliable estimates of tonnage and grade from drill information because of the characteristic irregularity in thickness and grade of ore deposits. Many orebodies are discontinuous and consist of a group of ore lenses connected by low grade ore or weak mineralization. In some places, thick ore gives way abruptly to barren sandstone; elsewhere, mineralization declines gradually from ore through mineralized rock to barren ground. Thus, the combination of irregular geometry and erratic mineralization makes the deposits difficult to evaluate.

Most exploration is done with vertical drill holes. Quality of information obtained depends upon the drilling and sampling methods used. Grade is determined from assays of drill core or cuttings, or from radioactivity measurements taken by a gamma-ray logging unit. Sample density depends on hole spacing, which varies from a few feet to several hundred feet, depending on depth to the ore horizon, size of expected deposits, and drilling costs. Cost of exploration usually does not permit drilling in such detail that every irregularity in an orebody can be accurately determined. Therefore, the sample information is inadequate to "block out" ore in the usual en-



REALIZED GRADE for this large producer was 0.34% U_3O_8. This was less than the estimated grade of 0.44% because of normal dilution during mining.

Mr. Wright is the manager of Western Exploration for American Metal Climax, Inc., Denver, Colo. He is the author of the following E&M.J articles: "What the Prospector Should Know About Uranium," January 1953, pp 99-94, and "Where to Look for Uranium," September 1954, pp 91-95.

Table 1 Summary of Reserve Calculations

Mine No.	Calculated reserve				Production				Realization factor				Calculations by
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Tons	% U_3O_8	% V_2O_5	Gross Value*	Tons	% U_3O_8	% V_2O_5	Gross Value*	Tons	Lb U_3O_8	Lb V_2O_5	Value	
1	13,920	0.87	1.60	$1,125	9,063	0.26	1.12	$ 260	1.6	0.3	0.8	0.2	1
	5,946	1.75	2.09										2
	5,225	1.15	2.21										3
	7,943	1.66	2.62										4
	12,054	1.58	2.20										5
	2,486	1.67	2.74										6
	9,652	1.46	2.25										7
	3,430	1.48	2.56										8
Ave.	7,582	1.45	2.28										
2	39,000	0.47	1.28	$1,270	93,000	0.28	1.18	$2,875	3.3	2.4	3.0	2.3	1
	17,368	0.37	1.27										2
	24,700	0.38	1.20										3
	30,963	0.37	1.28										4
	33,058	0.37	1.29										5
	28,094	0.37	1.29										6
	41,102	0.38	1.33										7
	28,626	0.37	1.31										8
Ave.	30,364	0.39	1.28										
3	1,000	0.28		$ 23	1,111	0.34	1.23	$ 41	2.1	1.6	...	1.8	1
	504	0.48											2
	555	0.43											3
	512	0.45											4
	675	0.45											5
	251	0.48											6
	763	0.42											7
	528	0.51											8
Ave.	599	0.44											
4	1,950	0.29	0.62	$ 73	573	0.32	0.69	$ 18	0.3	0.2	0.3	0.3	2
	1,420	0.30	0.56										3
	3,509	0.26	0.62										4
	3,573	0.26	0.63										5
	1,526	0.30	0.62										6
	3,400	0.26	0.63										7
	3,179	0.30	0.62										
Ave.	2,651	0.28	0.61										
5	410	0.27	0.55	$ 15	985	0.21	1.11	$ 23	1.6	1.8	3.5	1.5	1
	514	0.24	0.51										2
	690	0.23	0.50										3
	669	0.25	0.54										4
	671	0.24	0.63										5
	666	0.29	0.50										7
	745	0.25	0.49										8
Ave.	624	0.25	0.53										

*Gross value is stated in thousands of dollars.
Does not include initial production bonus or haulage allowance.

gineering use of the word, meaning ore which is accurately measured on three sides.

The mine operator judges the accuracy of ore estimation by comparing the production realized from a mine with the reserves which were originally predicted to be there. This type of comparison provides a measure of the accuracy and completeness of drill information, the accuracy of reserve estimation methods, and the effect of mining method on ore recovery and dilution.

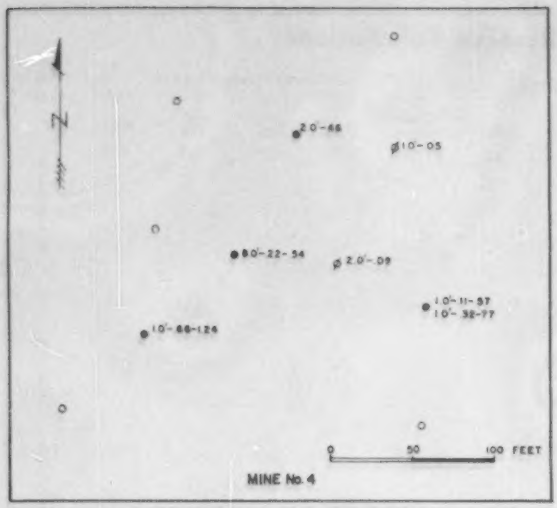
A study of ore calculation methods has been made by Bush and Stager for certain deposits drilled by the Geological Survey in the Uravan Mineral Belt (Bush, A. L. and Stager, H. K., Accuracy of ore-reserve estimates for uranium-vanadium deposits on the Colorado Plateau: USGS Bull. 1030-D, pp 131-148, 1956). Thirty deposits were studied in which at least 25% of the estimated reserves had been mined. Ore estimates had been originally prepared on drill information. After development, the mines were mapped, and revised reserve estimates prepared from drill data coupled with information from the mine mapping. It was found that the estimate of tonnage for all 30 deposits was about 15% greater than the original estimate; grade was approximately the same. In spite of the apparent accuracy for the group of deposits, however, estimates for individual deposits ranged widely from large underestimates to large overestimates. Lack of sufficient drill hole data was considered the basic source of error.

Of course, the Geological Survey report is preliminary since very few, if any, of the deposits studied (number unspecified) had been mined out at the time of mine mapping. An accurate analysis of reserve calculation procedure must be deferred until the orebodies are exhausted. Only then can total realized production be compared with production expected from drill hole information. The Survey study suggests that the method of ore reserve estimation is fundamentally sound and for a number of deposits the errors are compensating. The mine operator, however, faces the need of attaching reasonably accurate figures to each individual deposit. For most purposes an error on the conservative side is not critical, but under certain circumstances — such as negotiating for a new property—underestimating may be as unfortunate as overestimating.

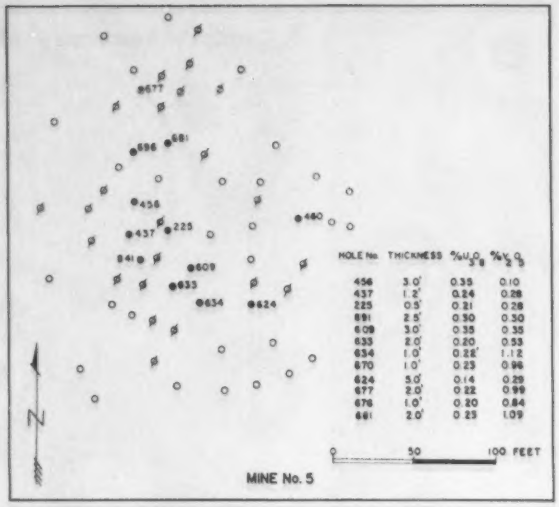
Method of Experiment

As a check on the ore estimation methods used by Climax Uranium Co., five company operations were selected for review. Four of these deposits had been mined out and are now abandoned; the fifth is so nearly mined out that a reasonable estimate of the ultimate production can be made at the present time. The examples selected are not especially average or representative; in fact, deposits illustrating overestimation and underestimation of reserves were chosen so that the distinctive features of these deposits might perhaps be recognized. All mines are in the Salt Wash member of the Morrison formation and are situated in the Gateway Mining District, Mesa County, Colo., a portion of the Uravan Mineral Belt.

Sets containing five maps each were prepared showing drill holes and assays for each orebody. All ore is on a single general level in each deposit. The mines were not identified in any



THIS MINE produced less than one-third of the expected value of ore because adequate drilling was uneconomical.



VANADIUM CONTENT in this mine was higher than expected because drilling missed high-grade vanadium.

way and no reference was made to any earlier reserve figures. Sets of maps were given to company geologists and to the Ore Deposits Branch of the Atomic Energy Commission, which kindly cooperated in the work. In this way a number of independent calculations were obtained so that an average reserve figure could be established for each deposit. In addition, the work of each individual could be compared with others.

Results of Experiment

Results of the calculations are summarized in Table 1. The reserves estimated by individuals, identified by numbers in column number 14, are tabulated in columns 2, 3 and 4. Total production from each mine (estimated for Deposit No. 2 which is not completely mined out) is listed in columns 6, 7, and 8. Column 10 relates produced tonnage to estimated tonnage by use of a realization factor, obtained by dividing tons produced by tons calculated. A mine which produced exactly the estimated tonnage would show a realization factor of 1.00. If production was twice the estimated figure, the realization factor would be 2.00. If production was half the estimated figure, the realization factor would be 0.50. Realization factors were calculated for uranium content and vanadium content, and are listed in columns 11 and 12 respectively. The realization factors for gross ore values are listed in column 13 and relate the value of ore actually extracted to the anticipated value of the ore.

Five maps used for the study are illustrated. Drill holes are classified as follows: ore—solid circle; mineralized —open circle with line; barren—open circle. The figures show (reading from left to right) thickness of or (in feet), percent U_3O_8, percent V_2O_5. Some vanadium assays are missing.

Production from Deposit No. 1 has fallen short of expectations and the operation was not profitable. Although the mine produced 63% more tons than estimated, it has yielded only one-third the estimated amount of uranium. The contrast between the calculated grade of 1.45% U_3O_8 and the realized grade of 0.26% U_3O_8 reflects the fact that high-grade ore pockets intersected by drill holes were small and lacked continuity. Low-grade ore was blended with the high grade to maintain tonnage and extreme dilution resulted. A possible clue to the spotty character of the ore values is in the irregular distribution of values as shown on the drill map for Mine 1. The varying interpretation which can be placed on drill information is reflected in the wide range reserves calculated by eight individuals, as shown in Table 1. From the mining standpoint, the wide scattering of ore holes has meant high development and haulage costs.

Deposit No. 2 has been a large producer, by Salt Wash standards. From the ore calculation standpoint it has proved a pleasant surprise, overmining both as to tonnage and metal content. Although ore thicknesses of up to 20.5 ft were indicated by drilling, the thickest portions of the orebody were not cut by the holes. Realized grade, 0.28% U_3O_8 ,is lower than estimated grade, 0.39% U_3O_8, as a result of normal mining dilution, here due partly to the use of large, trackless mining equipment.

Deposit No. 3 is a small orebody outlined in detail by close spaced wagon drill holes at shallow depth. Assays were made on drill cuttings. The deposit overmined both in tonnage and metal content. Realized grade, 0.34% U O , is less than estimated grade, 0.44% U_3O_8, because of normal mining dilution. Although the deposit was carefully mined by selective methods, thinness of the ore caused unavoidable dilution.

Deposit No. 4 was outlined by fairly scattered core drilling. Before development was started, additional drilling was considered to confirm the estimated reserves but it was decided that further drilling expense was probably not warranted. The mine produced less than one-third the expected value of ore. If further drilling had been undertaken, the lack of continuity would have been demonstrated.

Like Deposit No. 3, Deposit No. 5 was outlined on closely spaced centers by shallow wagon drill holes. It overmined in tonnage and metal content. Grade of ore shipped was 0.21% U_3O_8, representing slight dilution below the calculated grade of 0.25% U_3O_8. Below 0.20% U_3O_8 the value of ore falls abruptly, because of the AEC sliding scale price schedule, and miners usually attempt to hold uranium grade above 0.20% U_3O_8. The high vanadium content of shipped ore, double the calculated value of 0.53% V_2O_5, is unexplained but must be due to an unusual concentration of vanadium minerals not drilled.

What We Learned

1. The method of reserve calcula-

(*Continued on p 188*)

E&MJ went underground at Pronto last July with Paul Young, mine manager (far left); Dr Robert Heim, Coldstream Copper geologist; Don Zimmerman, Australian AEC geologist (center); Ted Hanson, shift boss and Paul Park (right) Pronto's captain.

How Pronto Cut Dusting At Dumps and Passes

MINE VENTILATION at Pronto Uranium Mines Ltd., during the past three years, has been good generally; but locally, certain areas —those adjacent to the central ore pass, isolated stoping blocks and in long dead-end headings—were very dusty and poorly ventilated. In 1956 work was started to clean up the difficult areas. Through the courtesy of Paul Young, mine manager, two Pronto engineers tell how the job was done. Some idea as to the effectiveness of the changes made in the mine can be seen in the accompanying table, showing dust counts before and after the alterations—proof that effective dust control can be achieved near underground ore dumps.

Conditions in the Mine Before the Changes

HAROLD PUDNEY

PRONTO MINE is ventilated by a 73-in. Sheldons, single-stage, vane-axial fan that delivers approximately 150,000 cfm of heated air into a central ventilation raise. As indicated in shaft section, the ventilation raise conforms to the orebody from the first to the third level, and then is brought back to the shaft at depth. Fresh air is bled from the ventilation raise as needed onto each level, the amount escaping at each level regulated by the use of doors and bulkheads.

The air then finds its way to surface through the main shaft or any of the 20 surface breakthroughs. A 50,000 cfms exhaust fan has been set up over the eastern most surface raise to augment airflows in the more remote areas, and to ease the problem of coursing fresh air to the active workings.

Shaft sinking was reduced as much as possible during the early (1955-1956) stages of mining, so the loading station was located as close as feasible to the fifth level (bottom). Development work proceeded on all levels; but production mining was limited to the upper four levels, because storage capacity in the lower sections of the pass was limited. The lack of storage capacity led to the installation of an ore grizzly at each producing level. Some additional storage capacity was obtained by slashing the grizzly finger raises below the third and fourth levels. Finally, the ore pass was extended to the surface to facilitate stockpile recovery.

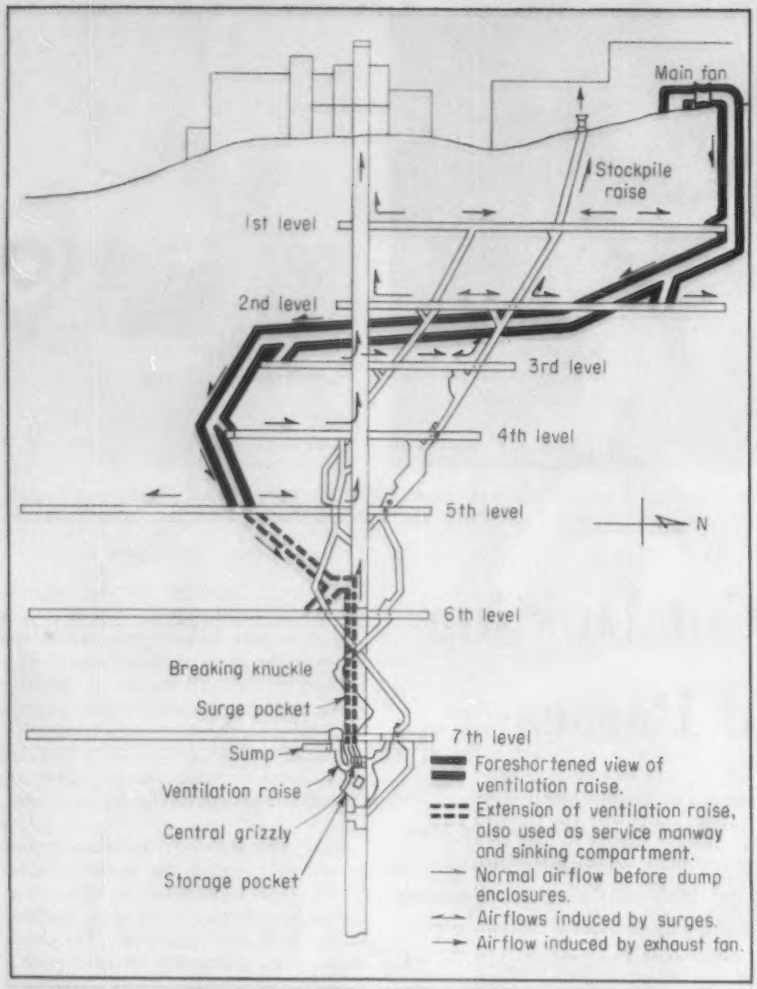
Waste rock broken in development headings is more thoroughly fragmented than run-of-mine ore, and secondary blasting is rarely required. The waste pass grizzlies were, therefore, enclosed by means of trap doors or guillotine doors and presented no special safety or dust control problems.

As air from the ventilation raise sought the most direct route to any surface opening, the open ore pass became an upcasting airway parallel to the shaft, and air entering the pass at one level could escape into the mine at another level. Ore falling down the ore pass created enormous amounts of airborne dust. Since the

Changes Reduced Dust Load

	Before	After
	(Particles per cubic centimeter)	
Head frame	672	310
1st level station	1,370	293
2nd level station	845	279
3rd level station		235
1st ore pass dump while dumping	Too many to count	308
2nd ore pass dump	1,000	194
3rd ore pass dump	Too many	449
7th level grizzly		231

Mr. Pudney is ventilation engineer and Mr. Kneen is planning engineer at Pronto Uranium Mines Ltd., Algoma Mills, Ontario. This article is based on Mr. Kneen's paper at the 8th Conference on dust control and ventilation before the Mines Accident Prevention Association of Ontario, 1959.



ORE dropped at ore passes dirtied the upcast air and created back pressure which in turn caused air surges to take place in the mine every time a car was dumped.

dumping frequently averages more than one car per minute, the air was highly contaminated with dust once it entered the ore pass.

Not only did the ore hurtling down the ore pass contaminate the upcasting air, but it also caused a back pressure which in turn caused a surge of air from the ore pass up through the grizzly rails at each level as the falling ore approached. The first carload of ore falling down the pass contaminated the air and reversed the airflow, while each subsequent carload further polluted the air and forced a surge of dusty air back through the grizzly and eventually into the mine air—an upcasting airflow of 30,000 cfm was reversed at about the same rate during the dumping of a six car train from the level above. Four tramming crews operating on the first and second levels maintained these back surges for approximately 20% of the working time at the third level, and the normal ventilation when re-established required an almost equal time to push the contaminated air back into the ore pass.

When two or more trains were dumped in succession, the volume displaced from the ore pass doubled or even tripled before normal ventilation was re-established. Since space for this volume of air was not available in the vicinity of the grizzlies, the contaminated air was forced into the general mine air and into the shaft. These surges became serious as soon as the mine began producing from more than one level. They also resulted in unstable airflows in remote sections of the mine and increased the difficulty of providing equitable air distribution.

Another cause of contamination was secondary blasting, which was done at random times on any level. Clearing of blasting smoke was complicated by the surges already described. Some part of the blasting smoke was invariably carried into the main shaft by the mine ventilation and resulted in poor air conditions in shaft stations and in the headframe.

Finally, mine air was contaminated by the excess airborne dust raised during the car cleaning operation, which was usually expedited by the use of a blowpipe. The cars were usually cleaned at least once a shift so that the time of dust exposure from this source was, perhaps, of less consequence than from the sources already mentioned.

Measures to control dust exposure were imperative and could not be deferred. Protection of the men exposed to these dust hazards was initiated by issuing dust masks, especially to the grizzly operators who worked in the greatest dust concentrations. This, of course, was only a first step, as the use of respirators is difficult to enforce.

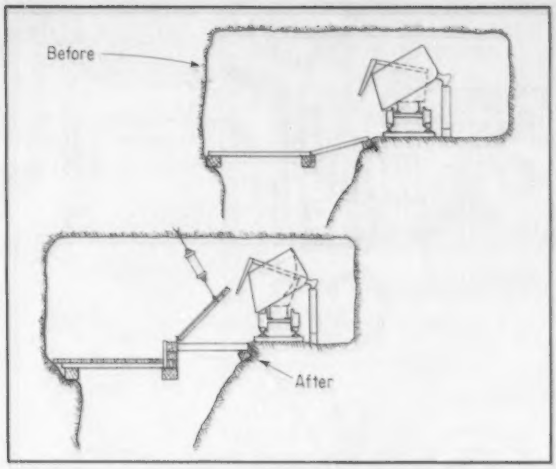
The first really effective countermeasure was the installation of control chains in the ore pass above the fourth level, which virtually ended all surge problems below the third level, thus limiting the hazardous area and enabling the subsequent steps to become more effective.

Ventilation doors were installed between the shaft and the passes on all levels. Regulators were fitted in the doors to allow normal air flow to the shaft. Dilution of the smaller volume of dusty air entering the shaft at any station into the air stream normally upcasting the shaft served to reduce the hazard in the shaft area.

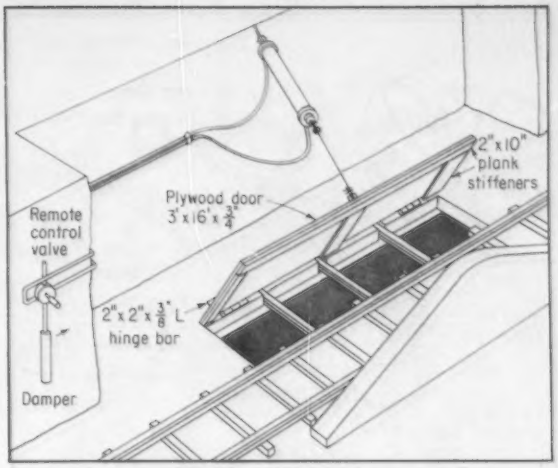
An exhaust fan of 30,000 cfm capacity was installed over the collar of the surface stockpile raise to keep an increased air current upcasting the ore pass, reducing the time lapse between surges occurring and the return to normal airflow.

Ventilation doors were tried in the third level haulageways to isolate the ore pass grizzly from the mine. Two types of doors were tried but each presented its own maintenance problems. First to be tried were air-actuated steel doors, operated by the motorman from the mine side only. These doors were located some distance from the grizzly to prevent damage from blasting. Several accidents occurred through malfunction and carelessness. Difficulty was also experienced in enforcing the use of the ventilation doors; this situation was aggravated because two sets of doors were required to effect proper control.

A second type of door known as Crash-a-Door, was tried in a location close to the grizzly. Failure of these doors occurred when it became necessary to reverse a train which was only partially through the doors. This resulted in tearing of the rubber



CHANGES at level stations included reducing the station area and using grizzly rails (4-ft centers) just below track level.



EACH dump was fitted with an air-actuated plywood door which effectively isolated the ore pass from the haulage way.

belting from the frame of the doors. Later experience indicated that insufficient clearance was allowed between the outer edge of the cars and the hinge bars of the doors, and this increased the damage done to the door in the failure mentioned above.

The rubber Crash-a-Doors have been tried elsewhere in our mine and found satisfactory. Repairs to the belting or spring replacement are simple.

Controlling the quantities of air bled from the ventilation raise at each level enables some control to be maintained over the normal airflows in the shaft and passes. Effective control in this way is contingent upon the ventilation demands in other parts of the mine, and is, therefore, limited in its application.

Modifications to ore cars and ore dumps were initiated on a small scale. Details of these changes are discussed later in the paper.

Installing the New Ore Pass System

THOMAS KNEEN

AS THE FOURTH LEVEL was developed, the need to deepen the shaft became apparent and the decision was made to proceed with a shaft extension program to develop all the presently foreseeable ore. An opportunity was hereby afforded to correct the faults inherent in the original ore pass system. Many features to control dust were integrated into mine planning, contributing substantially to improved air conditions both in the shaft area and in the mine workings.

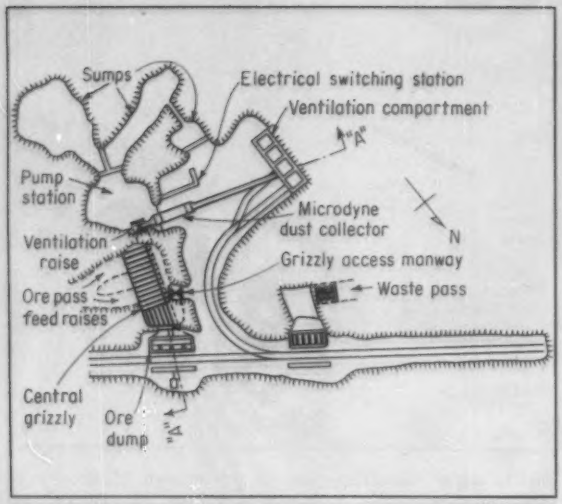
Several factors divorced from dust control were considered in the design of the new ore pass. First, the mine was scheduled for a five day week in July 1958, and it was hoped that production could be maintained without excessive overtime. Second, an underground crusher or central ore grizzly promised a potential decrease in manpower. Economy studies showed that a central grizzly was to be preferred, both for lower capital cost and lower over-all cost for the anticipated life of the operation. Both of these factors called for substantial ore storage facilities below the bottom producing level, storage facilities that fitted well into our dust control planning.

Headroom for a surge pocket of 1,000-tons capacity below the rails of the central grizzly was allowed in calculating the ultimate depth of the shaft, and alternate means of force feeding the bottom level ore into the back of the storage pocket was considered in laying out the shaft workings. A further storage pocket of 500 tons capacity was provided upstream of the grizzly feed raises, and above this was driven a knuckle-back in the ore pass which forms a positive breaking surface for all the ore falling from the upper six levels. The knuckle and the storage pocket directly below it reduced the amount of secondary blasting required. Together they constitute a positive dust control measure.

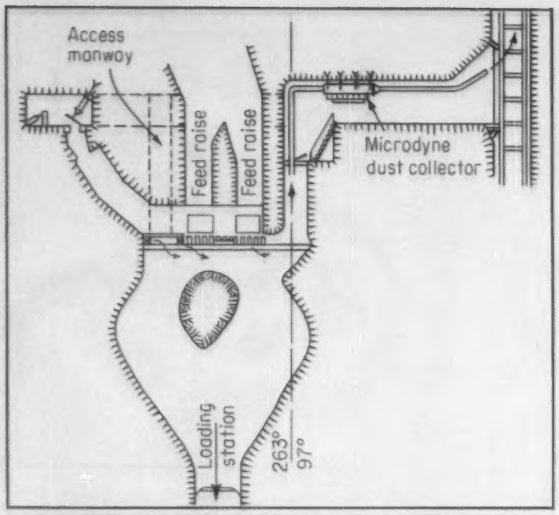
Upon the design of the central grizzly hinged the success of the whole mining operation, since the entire mine production must pass through it. Choke feeding afforded the most direct and simplest means of controlling the flow of ore into the grizzly. Two feed raises were driven at a 35° angle for four rounds, at 4x6-ft size. Brows were kept low to limit the extent of the ore pile on the grizzly rails, and provision was made for the installation of control chains in either of the feed raises in the event of undesirable flooding characteristics developing. The grizzly rails were arranged in a divergent pattern to prevent oversize pieces from jamming between the rails, especially under the muck pile. Once ore filled the feed raises, it effectively plugged the raises, and thereby blocked the passage of air currents.

Secondary blasting, which had formerly been done by sand blasting, is now accomplished by drilling and blasting plug holes. Sand blasting on the grizzly is now strictly prohibited because of the excessive shock waves propagated by the larger charges of powder required, and the proximity of the grizzly to the shaft station and the sump. Smoke produced by secondary blasting is, therefore, greatly reduced, and the frequency of blasts is also greatly reduced because a greater number of shots can be fired at one time, and also because of increased fragmentation in the ore pass above.

A ventilation raise was driven from the storage pocket below the central grizzly to the pump station just below the seventh level. Through this raise, all dust-laden air and blasting smoke are drawn from the grizzly, all contaminants are thus drawn down through the grizzly rails away from the operators. The dimensions of the grizzly chamber were kept modest to



ALL dust-laden air and blasting smoke in the grizzly station are pulled from the area through the pump station raise.



ONCE ore filled the feed raises of the central grizzly, it plugged the raises and blocked the passage of air currents.

allow a rapid air change. Blasting smoke and dust are treated in 6,000-cfm Microdyne wet-type dust collector which is sufficient to produce one air change per minute in the grizzly chamber. Wire mesh landings are used in the access manway to the grizzly chamber to withstand blasting concussions and to permit free passage of ventilating air.

Granby-type cars are used almost exclusively for both mining and development. Some modification of dumps, ramps and cars was planned for the newly developed sections of the ore pass. The changes were designed to reduce the dumping distance, to give a steeper dumping angle to the car bottom and to give a faster dump, all tending to throw more muck from the car.

Care was taken to limit the excavation of new ore pass dumps to 4-ft in width by 16-ft in length. Horizontal grizzly rails were spaced at 4-ft intervals, just below track elevation. The spacing provides openings large enough to pass the biggest pieces which can be dumped from an ore car. An air operated trap door was fitted over each dump, effectively isolating the ore pass from the haulageway.

Previously, ore dumps had been 20 ft in length. The reduction in length was made possible only after modifications to the dump ramps and the ore cars. Shortening the length of the ramp was accomplished by eliminating the flat center section of the dump ramp, steepening the slope of the approach ramps and forming a three foot radius crown between the approach ramps.

A strong tendency for the car chassis to tilt and run off the track while passing over the new dump ramps was noted. All ore cars on the affected levels were equipped with a roller type outrigger which passed beneath a 4x4½-in. angle guide fitted to the front face of the dump ramp.

Ore cars were further modified by fitting each car with a false bottom. This consisted of a strip of rubber conveyor belting attached about halfway up the fixed side of the car and free on the remaining edges. Ideally, the curve of the belting should be concave downwards to provide some springiness and motion as the car is dumped, and tend to prevent fines from adhering and building up on the belt. Relative motion is also imparted to the belt at the dump by the tendency for the belt to hang from the fastened edge. In turn, this steepens the inclination of the belt, assisting the fines to run out of the car. Even when the belt does not move relative to the car during dumping, the job of cleaning cars is facilitated by flexing the belt manually to break free the cake of fines. The use of compressed air to clean ore cars was greatly reduced after the belting was installed.

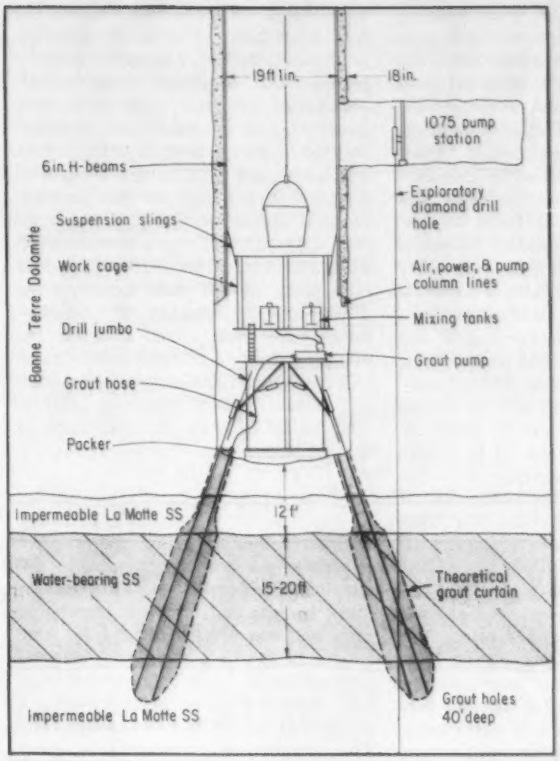
Upon completion of the new central grizzly, the ore pass was broken through to the original ore pass system at an elevation slightly below the fifth level.

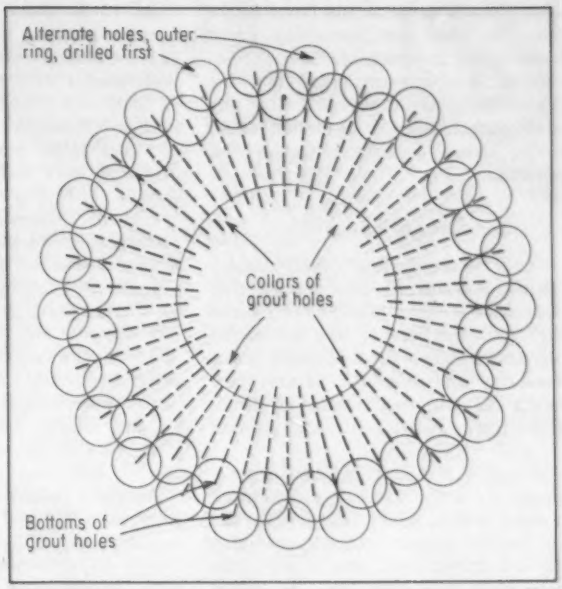
At last it was possible to modify the grizzlies at each producing level, and no time was lost in undertaking this program. First, the inclined row of rails was removed; then the center support beam was built up to about 8 in. below track level using 8 in. timbers. Next, the grizzly rails were replaced on the elevated bunk, approximately horizontal and at 4-ft spacing. A trap type or flop door was hinged at the center bunk and a remotely controlled air cylinder was added to operate the door. Light steel plate with angle bracing was used for several doors, the remainder being constructed of three-quarter-in. plywood bolted to an angle iron hinge bar. Finally, all open spaces on the rear deck of the grizzly were planked over and all openings were sealed off to complete the alterations.

Chelating Resins Prefer Heavy Metal Ions

CHELATING RESINS—ion exchange resins incorporating chelates in their structure—have been produced experimentally, and show superior selectivity and high absorption capacity for heavy metal ions according to Lloyd D. Pennington and Max B. Williams in INDUSTRIAL & ENGINEERING CHEMISTRY, June 1959, pp 759-62. Chelating resins absorbed more heavy metals ions than they did calcium or magnesium while carbolxylic and sulphonic acids types showed very little differentiation.

Chelates used included resorcinol, β resorcylic acid, resacetophenone, o-aminophenol and 8-quinolinol. The o-aminophenol and 8-quinolinol resins were similar in performance, except that quinolinol shows greater absorption at low pH. Resin chelates can extract trace amounts of heavy metal ions from concentrated salt solutions, or dilute solutions.





ALTERNATE HOLES were pumped to permit complete gelation. Blinding of interstices around holes reduced initial penetration, necessitated drilling of additional holes.

HEAVY INFLOW of water at Meramec Mining Co.'s iron ore site was effectively blocked by a curtain of chemical grout. Interstitial structure of sandstone prohibited cement grout.

Chemical Grout Technique Solves Meramec Shaft Sinking Problem

LEE BILHEIMER

CHEMICAL GROUT has been effectively used by Meramec Mining Co. to seal off a permeable, water-bearing sandstone prior to penetration by shaft-sinking. Six days of sinking time were lost to the grouting operation. Overall costs were nominal.

Meramec Mining Co., a joint venture of St. Joseph Lead Co. and Bethlehem Steel Co., is developing a large iron ore deposit 60 miles southwest of St. Louis, near the town of Sullivan, Mo. Two 19-ft 1-in. I.D. circular shafts are being sunk in the footwall to exploit a large magnetite-hematite orebody. The shafts will be about 3,000 ft deep. Production of iron ore is scheduled to begin in 1962 at a rate of 12,000 tpd.

The deposit is steeply dipping, massive, and occurs entirely within a Pre-Cambrian rhyolite-porphyry. Over 1,200 ft of Cambrian and early Ordovician sediments overlie the basement igneous rock with sandstone, dolomite, dolomitic shale, and cherty dolomites comprising the section from basement to surface. There is an erosional unconformity between the Pre-Cambrian igneous host rock and the basal LaMotte sandstone. Part of the orebody is believed to have been removed by erosion.

The basal sandstone was known to be water-bearing from previous experience in St. Joseph Lead's mining operations in southeastern Missouri. A total thickness of 130 ft was indicated at the shaft site. Management was justifiably concerned about sinking large diameter, deep shafts through such a potentially dangerous formation which had not previously been penetrated by a shaft.

St. Joe's Mine Research Department was given the task of developing a method for sinking through the sandstone with the least delay and difficulty. Use of chemical grouting appeared to be most logical. Subsequent field experiments showed that no cement, fly ash, or clay slurries could possibly be injected into the sandstone. The interstices were simply too small. But field work proved that chemical grout could be injected. The sandstone is competent; particle size averages 0.25 mm.; porosity averages 10%; the grains are well-rounded to sub-angular, and the cementing material is both dolomitic and/or argillaceous. Frequently when there is almost no visible cementing material, sufficient secondary quartz growth is present to make the rock competent.

Permeability tests were conducted on a sandstone core taken from a surface diamond drill hole put down 75 ft away from the shaft site. A simple pressure chamber and hand pump were used to determine permeability in the laboratory. The results were then plotted against depth at pressures of 500 psi and 1,000 psi. Laboratory work revealed: (1) that permeability can vary widely within a few feet, (2) lack of visible cement usually means high permeability, and (3) much of the LaMotte sandstone is highly impermeable. This imperme-

Mr. Bilheimer is mine research engineer, St. Joseph Lead Co., Bonne Terre, Mo.

ability was a surprise and fitted nicely into the plan for bottoming grout holes in an impermeable horizon. Independent observers agreed that the permeability data showed that any shaft penetrating the formation could be in serious trouble if water were present.

Sandstone Penetrated

After investigating the various chemical grouts, it was decided that American Cyanamid's AM-9 offered the best solution to the particular problem because it could easily penetrate the sandstone. It was also easy to handle with equipment on hand, and offered precise control of gelation time.

AM-9 is a mixture of two organic chemicals in the form of a dry, white powder which, when mixed with water and the proper catalysts, gels at a pre-determined time into a stiff, rubbery mass. Gel time may be varied from a few minutes to several hours. The gel is reputedly insoluble, and will not deteriorate in the presence of moisture. Viscosity remains practically the same as water until a few seconds before gelation.

A 10% solution of AM-9 costs approximately $1 per gal. The average cement grout (assume one sack per 50 gal) costs only 6¢ per gal; however, a comparison of direct costs only is misleading. A gallon of chemical grout means an equivalent volume of solidified material in place, whereas only a fraction of cement slurry volume can be considered effective in place. Chemical grouting may also save time. Since labor costs in any grouting operation usually exceed material costs, time is important, especially when bringing a property into production. It is obvious that cement is preferable when there are large voids to be filled and injection is no problem. In the case of the Meramec shaft there was no choice but to resort to unusual methods.

During the month of November 1958, the No. 1 shaft reached a depth of 1,075 ft and excavation of a pump station began. Advantage was taken of this delay in sinking to probe the sandstone with a diamond drill hole from the pump station. The AX core was examined and tested for premeability. The results corroborated the tests on the initial shaft site hole. Water flow from the hole was carefully measured every 10 ft as the hole was drilled. It increased to 60 gpm within a 15-ft zone of permeable sandstone near the top of the La-Motte formation. No increase was noted after that. Flow confirmed the premeability indicated by the laboratory core tests.

At 15 ft above the water-bearing zone the grouting program was begun. The six 3½-in. bore rock drills on the shaft jumbo were each outfitted with 42 ft of 1-in. hexagonal sectional drill steel in 6-ft lengths. Special unrestricted water tubes were provided. Two-in. holes were drilled with tungsten-carbide bits. Fig. 1 illustrates the operation. In order to form an impermeable grout curtain of sufficient thickness around the shaft perimeter (Fig. 2) two rings of holes were drilled. Outer ring holes were collared on 2-ft centers. Holes were angled out 20° from the vertical and drilled 40 ft deep. Each hole would theoretically form a grouted cylinder 4 ft in diameter and require 240 gal of grout. A 10% void space in the 15-ft water-bearing zone was assumed.

Alternate holes of the outer ring of 32 were drilled and grouted first. This was done so drilling the remaining 16 would tell something of what had been accomplished with the first 16 holes. The six machines were aligned with a Brunton clinometer set on the power feeds. Since the jumbo was plumb and the boom arms swung about a central, vertical axis, it was only necessary to set the angle once on each drill. Extra sump pumps were installed to handle the anticipated flow. Only one machine was allowed to penetrate the zone until it was known just what flows would be encountered. The first hole flowed 30 gpm at a static pressure of 310 psi. Succeeding holes averaged 35 gpm, but with several holes open, the flows decreased to 20 gpm per hole. Each hole took about one hour to complete, i.e., to drill, extract 42 ft of rods, and insert a standard grouting insert with expanding rubber packer.

The Equipment

As shown in the drawing, the two-deck work cage, 16 ft in diameter and 12 ft. high, was hung just above the drill jumbo. The chemical grout was loaded on the bottom deck of the cage, placed on expanded metal grating, and covered with a tarpaulin. AM-9 powder comes in 25-lb cardboard fiber drums, and should be kept dry. Two mixing tanks, each having a capacity of 120 gal, were placed on the same deck. A batch was mixed in one tank while the other one was being pumped. Two 1½-in. discharge hoses ran from the tanks down to the funnel intake on the 10x3x10 duplex grout pump set on the top deck of the drill jumbo. A high pressure, 1½-in. 1500 psi grout hose was run from the pump to the grout packers. In the grouting operation, which was carried on round-the-clock, two men were used on the bottom to attach grout hose, check for leaks and measure the flow from holes. The latter operation is to measure how fast grout may be pumped into the hole, which in turn determines gel time. The men were given a list of the holes to be pumped and the order of pumping. Each hole was numbered by attaching a tag with waterproof printing to the packers. General procedure was to grout holes 90° apart around the circumference. This was done so that gelation would take place in one hole before being displayed by pumping an adjacent hole. Two men were used on the pumping deck to control grout intake and discharge rates and record pumping pressures. One man was used to mix the grout with the assistance of the job supervisor.

Flow Rate Test

Before injecting the material, a pumping test is recommended to determine the proper gel time. Water must be pumped in at a reasonable rate, and the pressure and total time necessary to inject the calculated volume of grout must be recorded. Gel time may be set accordingly with a margin of safety left for delays, etc. The assumption is made that grout can be injected as readily as water. In almost every case this is true.

Such was the case when using the chemical grout previously in the same shaft and sinking through a water-bearing, tightly fractured, vuggy dolomite. However in the sandstone, all did not go strictly according to plan. A pumping test with colored water indicated that all holes were connected by the aquifer, and that 240 gal could easily be injected in 10 minutes at 500 psi. A gel time of 20 minutes was decided upon and pumping began. Surprisingly, pressure began to build up rapidly on each hole after 50 gal had been injected. Each hole took only 120 gal at a final pressure of 1,100 psi. A total of 1,900 gal was injected. It is now believed that the sandstone slowly filtered out minor insoluble material in the grout, thus plugging the interstices near the hole. Further study has shown that filtration of the grout before injection is probably the solution to this problem. However when the problem arose, the only quick solution was to simply drill more holes to close the curtain. Three 40-ft test holes were put down in the middle of the shaft so that effectiveness of the operation could be judged as it progressed.

Seventeen more holes were put down on the outer ring on 2-ft centers. The holes made 25% less water than the first ones, and each hole took an average of 100 gal of grout or a total of 1,700 gal.

Eighteen holes were then drilled on the inner ring on 3½-ft centers. They were collared 18 in. from the outer ring, and angled out at 17°. With all other holes closed, each test hole flowed 15 gpm. Each hole then took 75 gal of grout, or a total of 1,350 gal. Twenty more holes were drilled on the inner ring to complete it. A total of 600 gal was injected. All holes leaking over 2 gpm were repumped with 5 gal of grout at 1,200 psi. The test holes were still flowing from 3 to 6 gpm, and therefore 30 more holes were put down on the outside ring 12 in. apart. Each hole flowed 10 gpm with all others closed. Only 20 gal of grout could then be injected into each hole before stalling pressure was reached. No test hole flowed over 2 gpm with all holes open. However with all other holes closed, each test hole made 12 gpm. It was obvious that the grouting had formed a relatively impermeable curtain, which leaked only enough to enable one hole to flow 12 gpm under considerable hydrostatic head. However, the curtain was able to prevent any substantial flow into the shaft area. Sinking was resumed and the entire sandstone section penetrated without difficulty.

Shaft sinking had been delayed six days. Grouting material cost $5,500, and a unique shaft sinking problem was overcome successfully and economically. The writer believes chemical grouting will be a most valuable tool in the mining industry. Its use calls for close supervision, but the results can be rewarding.

The writer wishes to thank the St. Joseph Lead Co. and Meramec Mining Co. for permission to publish this paper, and also the personnel of the two companies for their cooperation in the development and application of the grouting method.

Reactive Gas Grouts Air Drilled Oil Well

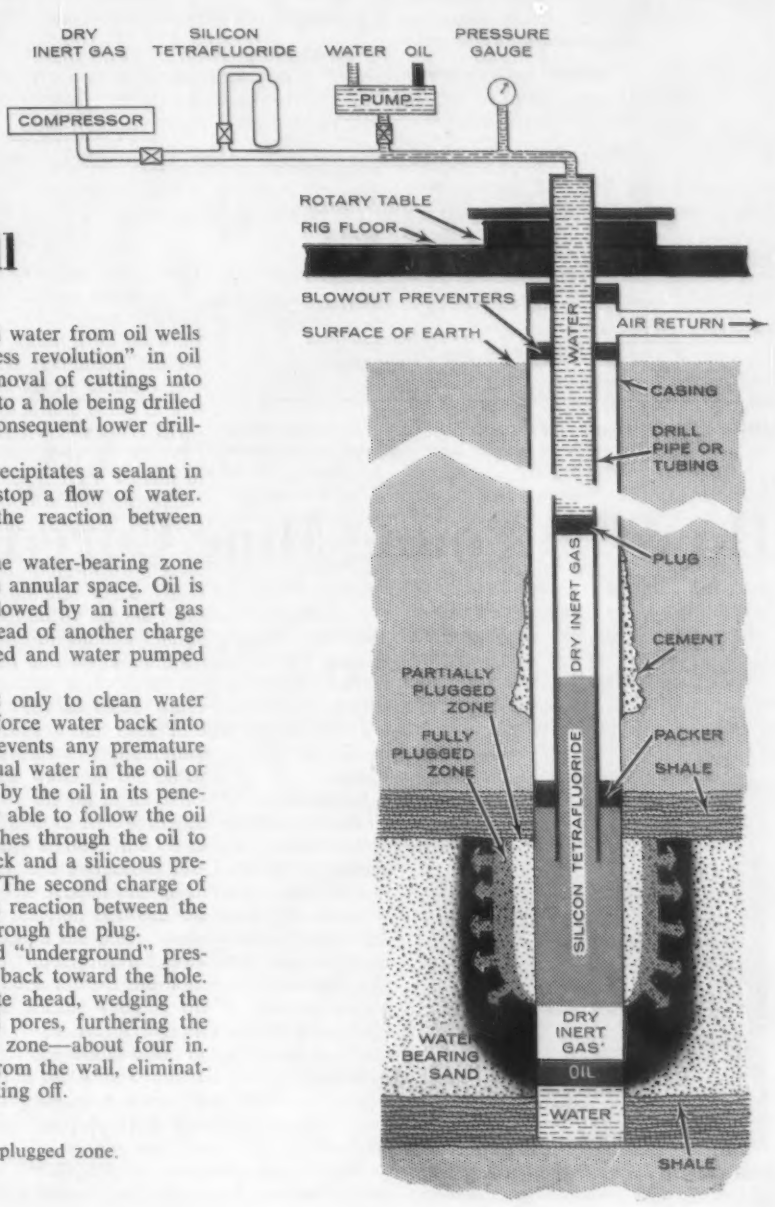
CHEMICAL GROUT can effectively seal water from oil wells as well as mine shafts. The "mudless revolution" in oil drilling methods has brought air removal of cuttings into wide use. But excessive water flow into a hole being drilled dry can force the use of mud and consequent lower drilling speed.

Gulf Oil Corp. now chemically precipitates a sealant in the porous rock around a hole to stop a flow of water. This ingenious idea is based on the reaction between silicon tetrafluoride and water.

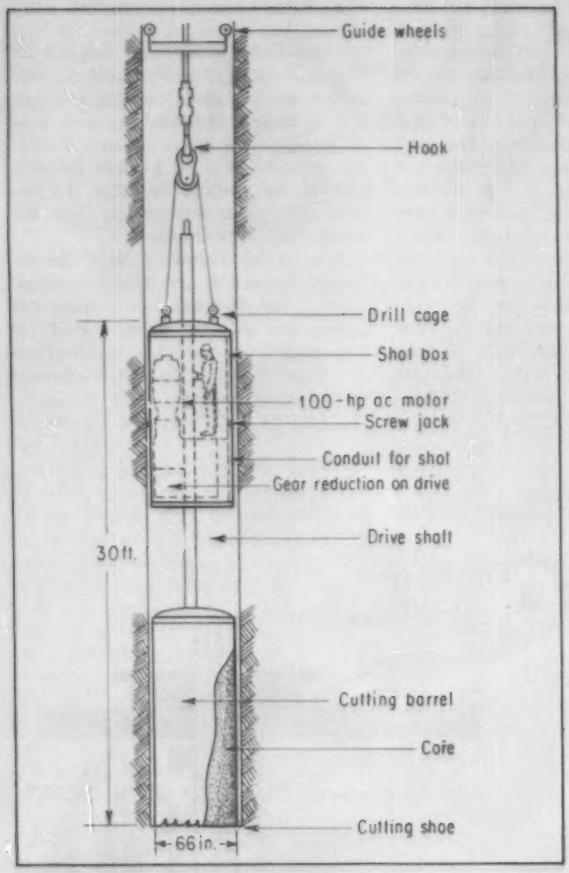
In the Gulf shut-off technique the water-bearing zone is isolated by a rubber packer in the annular space. Oil is then pumped into the hole, and followed by an inert gas (nitrogen). Then comes the SiF_4 ahead of another charge of nitrogen. The pipe is then plugged and water pumped in to apply pressure.

The oil is run into the hole not only to clean water from the wall of the hole but to force water back into the porous rock. Then nitrogen prevents any premature reaction between the SiF_4 and residual water in the oil or water which may have been missed by the oil in its penetration of the rock. The SiF_4 is now able to follow the oil into the porous rock and finally pushes through the oil to reach the water. The reaction is quick and a siliceous precipitate plugs the interstital spaces. The second charge of nitrogen serves as insurance against reaction between the SiF_4 and water which might leak through the plug.

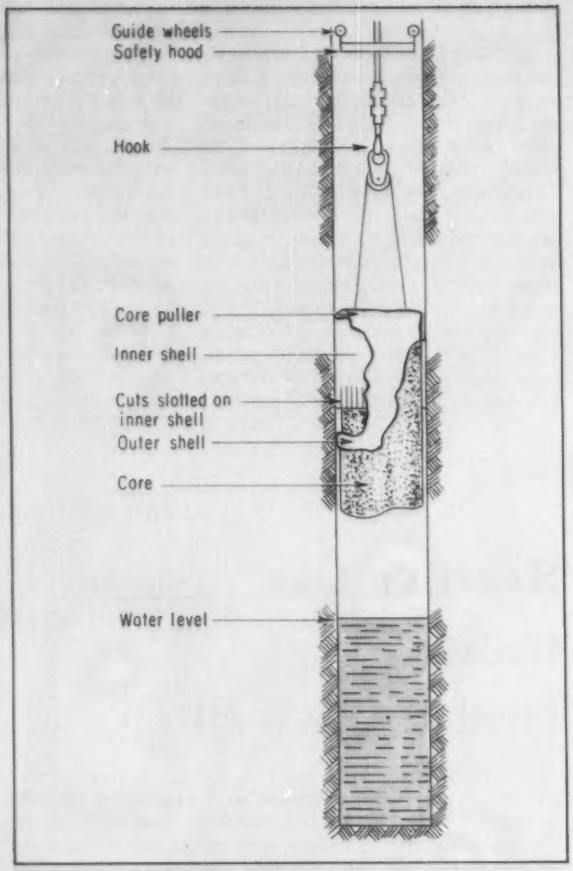
When gas injection is stopped and "underground" pressure takes over, the water is forced back toward the hole. The movement forces the precipitate ahead, wedging the solid particles tighter into the sand pores, furthering the plugging action. The fully plugged zone—about four in. in thickness—forms about two in. from the wall, eliminating the possibility of the sealant flaking off.



FAST SiF_4-H_2O reaction leaves fully plugged zone.



DRILL CAGE houses operator and vertically mounted 100-hp ac motor which operates cutting shoe through drive shaft.



WHEN A CORE is pulled, slotted fingers on inner shell of the core barrel grip core. Guide wheels steady puller in shaft.

How the Young Mine Cored an Air Shaft

THE DRILL was first used at Grass Valley, at Ely and later, on the Gogebic.

INCREASED VENTILATION at American Zinc Co.'s Young Mine, in Jefferson County, Tenn. was achieved with a 66-in. calyx core drill shaft, sunk to 650 ft by a three-man crew and a drill which had seen duty in the 30's in Grass Valley and on the Iron Range.

Planning of the Young Mine's Gismo mucking and A-C tractor combination indicated a need for ventilation beyond that furnished by several large churn drill holes established during development. The calyx drill shaft, upon completion, contributed another 100,000 cfm capacity. The following article describes the coring process at the Young Mine. Highlights of the Young Mine operation are listed in the column on the opposite page.

The calyx drill shaft site was placed 2400 ft from the main shaft. A 1-in. dia diamond drill pilot bore was used to explore the proposed shaft before drilling began. Cores indicated seamy dolomite, cut by a fault about halfway down. A possible heavy influx of water might require grouting if it proved to be serious.

The drill was originally a 60-in. rig built by J. B. Newsome. It was used by the Idaho Maryland Mines in 1936 to drill a 1,125-ft shaft at the Brunswick Mine at Grass Valley, Calif. Newsome later enlarged it 66 in. and added several refinements. Pickands, Mather & Co. sank a 1900-ft shaft at the Zenith Mine at Ely, Minn. in 1937-38 with the enlarged version of the drill.

Success of the Zenith shaft encouraged the owners to move the equipment to the Cary Mine on the Wisconsin end of the Gogebic Iron Range, where it was used on a 2600-ft ventilation shaft.

With completion of the Cary shaft, the drill was stored in a salvage yard. In 1956 Charles Dobbel, chief mining engineer of American Zinc, recommended buying the drill.

Replacement parts for the drill were made in the Mascot, Tenn. shops of American Zinc and new hoist cables replaced those showing signs of wear. It was also decided to replace the power cable and a length of air hose.

The drill system with core barrel and operator's drill cage is 30 ft long and weighs 15 tons. Core cutting barrel is 15 ft long including an 18-in. serrated-bottom cutting-shoe, 1½ in. thick, welded to the barrel. The cutting shoe or ring has a series of 8-in. teeth notched at an angle of 45° and spaced at 16-in. intervals around the periphery. The abrasive dolomite country rock at the Young Mine wore the teeth down rapidly and they had to be sharpened by recutting with a torch.

In drilling, the operator's drill cage is suspended above the cutting barrel and directly connected to it by a 6-in. dia drive shaft. Both units are lowered by derrick—auxiliary services and operator being lowered just prior to start-up. When in position, eight jackscrews are tightened to plumb the rig and prevent rotation of the cab as power is applied.

A vertically mounted 100 hp, 440 v, 3-phase ac motor is connected by reduction gears to the drive shaft to rotate at 52 rpm. Rotation translates to a peripheral speed of 853 fpm at the outer edge of the cutting ring.

Standing room is all that is available in the operator's cab since it contains the motor and drive, a wheel for positioning the cutting barrel, a hopper for shot and grit and an ammeter and pressure gage which briefs the operator on drilling progress. The cab is topped off with a steel lid to protect the operator. Further protection is provided by a 62-in. traveling safety hood suspended over the drilling compartment, core puller or bailer. The hood has twin sheave wheels hung beneath it and is equipped with rubber tired guide wheels to maintain center in the shaft. The hood is a permanent part of the hoist and all equipment is hung under it.

When a core is pulled, the operator's cage and cutting barrel assembly is removed and a core puller is lowered into the hole. The puller is equipped with an inner and an outer shell with the lower section of the inner shell cut into numerous fingers or strips. When the puller is lowered into the kerf, the fingers are forced inward to grip the core as tension is applied by the hoist. (The pilot drill hole had indicated a series of mud-filled partings which proved to make subsequent separation of the core a simple operation.) In case the core sticks or does not part from the bottom of the bore, a stick of dynamite is lowered into the kerf and electrically detonated.

Adequate inflow of drilling water was obtained from numerous seams so that extra water was not needed. Drilling sludge was removed with a round bailer which has a conventional inlet-discharge valve on its bottom. When hoisted to a level just above the collar, the bailer is dumped into a trough swung under it from the edge of the shaft.

A stiff-leg derrick with a 60-ft steel boom served as a mobile head frame on the job. An 18-in. sheave served the man hoist while a 48-in. sheave was used for the drill hoist.

A 200 hp Vulcan-Denver double-drum hoist was housed with the compressor and miscellaneous equipment in a steel frame, corrugated sheet building. About 4500 ft of non-rotating 1-in. rope was reeved through a traveling hook-sheave combination and twin sheaves to develop a four part set-up with a hoist speed of 70 fpm. A ¾-in. special rope was used on the 4-ft drum for men and supplies.

A third hoist was needed to operate the power cable reel, since the four-conductor cable weighed 31 lb per ft. A 15-in. sheave located on an angle bracket at the edge of the concreted shaft collar paid the cable in either direction.

The drill cage and cutting barrel are lowered into the bore with some 5 ft of water standing in the bottom. Bentonite is added to provide a drill-

Highlights at Jefferson County

Ore is hoisted by a 600-hp Allis-Chalmers unit with 10-ft drums having a hoist speed of 1,000 fpm. The man hoist is a 450-hp Ottumwa unit with a speed of 550 fpm. A 1½-in. rope is threaded on the main hoist, while 1⅝-in. rope is used on the ore hoist. Herringbone gears running in an oil bath furnish the speed reduction. Post type brakes are used. A controller for the hoists, having a main and an auxiliary motor for operation at lower drum speeds, is used. The controller is arranged so that when the large motor is engaged, the hoists may be operated at full speed. When the small motor is clutched in, drum speed is automatically reduced.

Haulage is by Sanford-Day bottom dump cars used in conjunction with a 13-ton General Electric locomotive. Allis-Chalmers diesel powered HD-6 tractors are coupled to Gismos for mucking. Conversion has been made from tracked to rubber-tired vehicles since the abrasive action of the dolomite caused too much maintenance.

Drilling is by four jumbo-mounted machines which drill 70 holes per round. Drill steel, 1⅛-in. by 17-ft long with integral carbide-tipped bits is used on most drills. Some drilling with detachable bits, sharpened underground, is carried out.

Blasting is with 60% dynamite in 1-in. by 2-ft cartridges loaded to an average of 300 lb per round. Millisecond delay detonators are used in the majority of cases with conventional electrical delays used on occasion. Leg wires are arranged in a series-parallel type circuit with an average of eight holes hooked up to the individual series to simplify balancing and checking the shot. The No. 6 gage circuit is fastened to special roof bolts and insulators in the back. The circuit terminates in a special lock switch with a bridge jumper which keeps the circuit dead until the switch is thrown.

Slabbing is performed by specially built light weight aluminum bars equipped with a steel hook-hammer combination. When all loose rock is barred down, the muck pile is used to mount air-leg drills to reach ore missed by jumbos.

The repair shop is set up about midway between the production area and the shaft in a stoped-out area. A 25-ton bridge crane hoists diesel equipment to cribbing for overhaul. Motor exchanges are made with the same crane. The shop is designed for all normal machine and maintenance work.

Power is supplied from 66,000 v ac primaries. Highest secondary voltage is 2,300 v, 3-phase, 60 cycle ranging down to 120 v. Most surface and underground equipment is powered with 220 v, 3-phase current. Heaviest load is the 200 kw motor-generator unit installed on the 276-ft station for powering the haulage system. Next are two 350-hp pumps on the 204 level and one 300-hp pump and a 350-hp pump in the sump.

The Coy Mine, American Zinc's newest Tennessee producer, has a 14-ft circular shaft lined with reinforced concrete in the upper 55 ft of heavy ground. Circular steel sets are hung at 8-ft intervals in the stronger dolomite for 750 ft to bottom. Flush with the headframe is a circular storage pocket with a structural steel tram at right angles to the railway spur and at a level with the upper grizzly section of the storage bin. The tram supports a conveyor belt. The belt is placed in the incoming ore stream to direct waste over the pocket to a pile at the side, or pulled from the stream when ore is stored for the concentrator at Mascot.

ing mud. With the derrick lined up over the drilling unit near the collar, a hook is lowered into position by the main hoist. Then the operator is lifted by the main hoist to a position for threading the hook through an eye and setting the safety lock.

The operator moves from his bucket onto the safety hood where he sends the bucket up and waits for the descending 440 v power cable, the 120 v lighting cord, air hose and communication line. While equipment is being lowered he climbs down a steel cable ladder hung from the safety hood to the shell of the drill cage. Each cable is threaded through its respective opening in the safety and drill hoods.

Entering the hatch, the operator plumbs the rig with screw jacks. Next he engages the drive shaft to the motor unit through the control wheel and starts the motor in low. Steel shot, ⅝-in. dia with an admixture of C Grit, is fed from a tube at the rate of 25 lb per hour and drilling speed is stepped up to maximum rpm. The cutting rate is read as amperes flowing in the lines. With an abnormal rise in the current, more shot is added as needed, or the possibility of a loose kerf or core is checked.

Drilling proceeds until the initial two-hour period has passed, at which time the operator is relieved.

If the core shears off due to faults penetrated, the rig is stopped, jacks loosened, lines disengaged and sent up, followed by the operator. The large hoist removes the cutting unit, which is swung over the work platform, and the main hook is disengaged in reverse order.

The large hook picks up the core puller and lowers it over the core. After the core is pulled, a small flat-car on rails receives the core and is run downgrade to the dump. Water and mud accumulated during the drilling cycle are bailed out, and any large masses of broken rock are mucked out before a new cycle begins.

As expected from the diamond drill cores, the upper strata broke into less than full length sections with lost drilling time as a result. With depth, the rock became more solid and 7-ft cores were pulled. At the fault zone in the middle of the shaft, water rose to the tip of the core barrel, but no other trouble occurred.

The three-man crew consisted of two drillers who alternated as surface men, and a hoist engineer; all supervised by a mining engineer.

Man in the News

Miles P. Romney—To Battle, Well Armed

A SINCERITY born of conviction is written on the rugged map of Miles P. Romney, the new chairman of the Emergency Lead-Zinc Committee, now in Washington battling for industry recognition.

But notwithstanding seven years struggle in lead-zinc matters as manager of the Utah Mining Assn. in what has become "a cause," Mike has no illusions.

He has proved he can "duck and weave" with the best of them—and still land a counterpunch.

At the age of 18, Mike won the 1922 welterweight boxing championship for the Intermountain Area—and now sports a broken nose in proof.

Another reason: He's an early "veteran" to the vicissitudes of life.

As a nine year old, Mike and his brothers (one is George W. Romney, president of American Motors Corp.) were chased out of Mexico by the Madera "revolutionists."

They were children of American citizens who had founded a Mormon colony.

"Mother and we kids caught the last train out," says Mike, who recalls lugging the family bedding into a ramshackle boxcar.

The men of Colonia Dublan, Mexico, where Mike was born Oct. 8, 1903, had to follow by another way a few weeks later, on horseback.

Later, between high school, boxing, and studies at the University of Utah, Mike found time to serve as a missionary for the Church of Jesus Christ of Latter-Day Saints at Johannesburg, South Africa. In fact, he designed and built the LDS chapel there.

In Salt Lake City he obtained a degree in geology in 1935 from the University of Utah. That same year, he married Janice Cahoon, daughter of mining man Leonard Cahoon of Salt

Lake City and took advanced studies at Columbia University.

On return to Utah, Mike says he "had the privilege of working as a geologist and field engineer (1936-1950) under Richard N. Hunt," vice president and head of the exploration department of United States Mining, Smelting & Refining Co.

Mike resigned from USSR&M to become general manager in March of 1950 of Duvall Co., a firm engaged in gold operations in southern Idaho. Following development of an open cut mine and construction of a 200 tpd mill, Mike and his stockholders discovered that the serious inflation of the early 1950's was wrecking the mining of gold.

His experience in the field gave him his credo:

"Fight for the survival of the domestic mining industry!"

On Jan. 1, 1952, Mr. Romney was named manager of the Utah Mining Assn.

As manager of the association, Mike was instrumental in hiking membership from 13 to the present 33. Several nonmetallic mineral companies joined.

The association became more active in the national scene—with Mike participating in two separate hearings before the U.S. Tariff Commission on lead-zinc matters. There were struggles elsewhere on uranium, tungsten, and other minerals.

Meanwhile, the Romney family found itself still growing in number (to five children) and in age (to college).

Jannie returned to college herself to pick up that degree in education she gave up when she married.

As a result: One school term last year the Romneys found themselves with a member of every class at the University of Utah—Jannie a senior; Miles P., Jr., a true "junior"; Leonard C. Romney, sophomore, and Wendy Virginia, a freshman. Jannie completed three years of college work in two years, is now teaching English at Granger High School in Salt Lake City County. Mike continues as manager of the Utah Mining Assn., while chairman of the lead-zinc group in Washington. The family stays in Salt Lake City, including Rosanne, 14, a junior high school student and Hannah, 10, about to move out of grade school come spring.

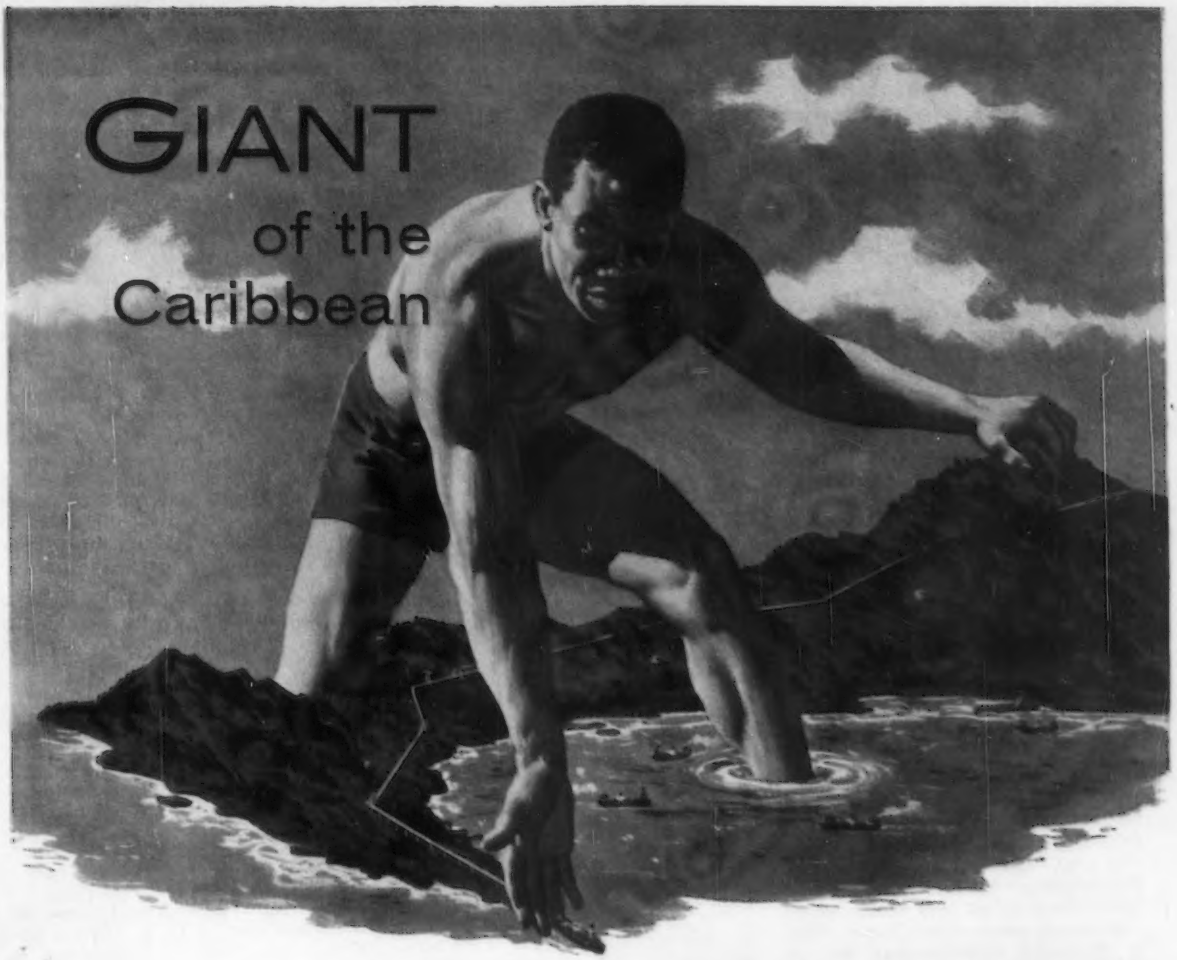
The immediate task at hand for Mike and Charles Schwab, the new general manager for Bunker Hill at Kellogg, Ida., whom he succeeds, is the Jan. 12 hearings before the United States Tariff Commission.

As Mike says, in pointed reference and out of his own experience:

"The U.S. mining industry is made up of many people—but most of all it is the small mine operator and prospector who has played a most important, although too often underrated, role."

US RUBBER CONVEYOR BELTS

GIANT of the Caribbean



In Jamaica, B.W.I., moving a million and a half tons of bauxite a year from back up in the hills to port loading facilities is a tough, complicated job. Climate, rough terrain, abrasion, great distances—all have to be overcome. Reynolds Metals Co. moves its bauxite production underground and overland on dozens of "U.S." Belts... first as cold, sticky, abrasive run-of-mine ore, later as crushed fines right from red-hot drying kilns.

"U.S." belting engineers, working closely with engineers of the conveyor system and of Reynolds, selected and designed the belts to handle the many different problems of movement and material. It's this specialized belting "know-how", plus the finest product available, that assures you of the right belt for the job every time.

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER

Mechanical Goods Division

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WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

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NEW BOOKS

Native Peoples of South America, by Julian H. Steward and Louis C. Faron. A condensation, or rather an abstraction, of a multi-volume work on the ancient and in many cases extinct peoples of South America. Treats the "old men" in their prehistorical, aboriginal and conquest stages of socio-cultural development. An interesting insight into the Incas, Jivaros, and the ancestors of the present native peoples of Bolivia, Chile and Argentina, etc. Published by McGraw-Hill Book Company, 330 West 42nd St., New York 36, N. Y. 471 pp. Illustrated. Price $8.50.

Fluorine Supplement (System No. 15), 1959 XVIII. Gmelins Handbuch der Anorganischen Chemie, 8. Auflage. The fluorine supplement treats the new knowledge acquired in the chemistry of the element during the years 1926 to 1949. The chapter on the manufacture of fluorine deals exclusively with the fused-salt electrolytic process. Chemical reactions take up 40 pages of the book, and an entire chapter is set aside for toxicity and handling hazards. Published by Verlag Chemie, Gmbh, Weinheim, Bergstrasse, West Germany. Can be obtained in the U.S. from Walter J. Johnson, Inc., 111 5th Ave., New York 3, N. Y., or Stechert-Hafner, Inc., 31 East 10th St., New York 3, N. Y. 258 pp. 31 graphs, cloth bound. In German. Price, $36.00.

Magnetics and Electrical Properties, Supplement to System No. 59, Iron, Part D, of the Gmelins Handbuch der Anorganischen Chemie, 8 Auflage, 1959. This volume also supplements Cobalt (No. 58), Nickel (No. 57), Manganese (No. 56), and Chromium (No. 52). Ferromagnetics are covered, as are iron (and alloys), cobalt (and alloys), nickel (and alloys), alloys of manganese, alloys of chromium, semiconductors; and all patents up to June 30, 1957 are included. Published by Verlag Chemie, address above. 580 pp., 308 graphs. In German. Price in wrapper is $77.04; cloth bound, $78.24.

Plant Engineering Handbook, edited by E. William Staniar and prepared by a staff of experts. Second edition. A compilation of engineering information on 92 major areas of plant organization, design, construction, operation and maintenance. The list of chapters is lengthy, and comprises a reference book on almost every subject or phase of engineering. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y. Illustrated, in more than 2,000 pp. Price $23.50.

Fluidization, by Max Leva. Covers all the major developments of fluidization fundamentals that have originated since fluidization became an important process tool. Phenomena, experimental data, working formulas are presented, and the book covers the latest technique—spouting—used on solids which do not fluidize readily due to size or shape. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y. Illustrated in 316 pp. Price $11.50.

Ten-Year Cumulative Index of the Transactions of the Institute of Mining & Metallurgy, Volumes 56 to 65, 1946 to 1956. Published in London, England by the Institute, 44 Portland Place, London, W.1. Price £1.

Brimstone, the stone that burns, by Williams Haynes. The exceptionally well-written story of a unique American industry—the production of Frasch sulphur. Did you know that Herman Frasch was a well-to-do man, with many successful patents already to his credit, when he brought in the first successful Frasch well?—that one critic had said in a technical journal that he would eat every ounce of sulphur produced by Frasch's ridiculous idea?—that one mine, still going strong, has produced more than 50-million tons of the yellow material? The mine is Texas Gulf's Boling, Tex. property, which first began pumping molten sulphur in 1929. Interesting, informative reading, full of detail and world production tables. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. Illustrated in 293 pp. Price $5.95.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

The Mining Ventures of This Ontonagon County, by James K. Jamison. Paperbound handbook details the mining activity in the copper mining camps of Michigan's Upper Peninsula from the end of the Civil War to 1950. The author died in 1954 before completing the work. Published by the Ontonagon Mineral Land Association Ltd., 525 River St., Ontonagon, Michigan. Maps and 90 pp. Price unlisted.

Handbook of Mathematical Tables and Formulas, by Richard Stevens Burington. Third edition. Formulas, theorems from elementary mathematics and tables covering almost all mathematical data needed by the engineer. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y. 289 pp. Price $3.00.

German-English Science Dictionary, by Louis DeVries. Third edition. Over 3,000 new entries have been added to the earlier edition. An appendix lists abbreviations, conversion tables, atomic tables, symbols, measurements and geographic names. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y. 592 pp. Price $7.00.

Steam Power Plants: Starting, Testing and Operation, by Charles D. Swift. A complete how-to-do in one volume. The book follows a steam plant from the drawings to everyday operating routine. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N. Y. 482 pp. Price $11.50.

Aluminum Construction Manual. Designed to serve the engineer and designer. Material on theory, derivation of formulas, definitions of terms and related subjects that regularly appear in textbooks have not been repeated here. Allowable loads, structural shapes available and alloy data covered in tabular form. Published by the Aluminum Association, 420 Lexington Ave., New York 17, N. Y. 381 pp. Price unlisted.

The Diamond Industry in 1957-1958, by Antoine Moyar. Present work brings up to 1958 the work begun in previous volume. Comprehensive coverage of the diamond industry. Available in English, French or Dutch. Available from Belgique-Congo et Commerce International, 24 Avenue Michel-Ange, N. Brussels 4, Belgium, or from Vlaams Economisch Verbond, 31 VII, Schoenmarkt, Torengebouw, Antwerp, Belgium. Illustrated in 131 pp. Price 100 francs (Belgian) or $2.00.

Mineralogy Concepts, Descriptions, Determinations, by L. G. Berry and Brian Mason. Designed to satisfy the needs of an undergraduate course for the beginning mineralogist as well as the one-timer. Emphasis is placed on general principles and to the significance of mineralogical data in interpreting geological phenomena. Crystallography, chemistry, physics, genesis, determination and systematics are covered. Published by W. H. Freeman & Co., 660 Market St., San Francisco 4, Calif. Illustrated in 599 pp. Price $8.75.

Engineering Thermodynamics—an introductory text, by D. B. Spalding and E. H. Cole. Thorough introduction to thermodynamic fundamentals, rather than applications, are stressed. Published by McGraw-Hill Book Company, Inc. Illustrated in 367 pp. Price $8.50.

Elements of Mineral Economics, by John J. Schanz, Jr. A paper-bound pamphlet developed by Pennsylvania State University as an introductory text for both resident and correspondence courses. Published by the Mineral Industries Continuing Education, College of Mineral Industries, Pennsylvania State University, University Park, Pennsylvania. 108 pp. Price $2.50.

Future Energy Sources For Pennsylvania, by John J. Schanz, Jr. et al. Study sponsored by the state planning board and conducted by the Mineral Economics Dept. of Pennsylvania State University. Covers atomic energy, coal, petroleum and natural gas. Predicts future population, fuel demands, fuel costs, fuel resources of Pennsylvania, Ohio and West Virginia, other energy sources and nuclear energy. Published by the Mineral Industries Dept., Pennsylvania State University. 156 pp. Price $3.00.

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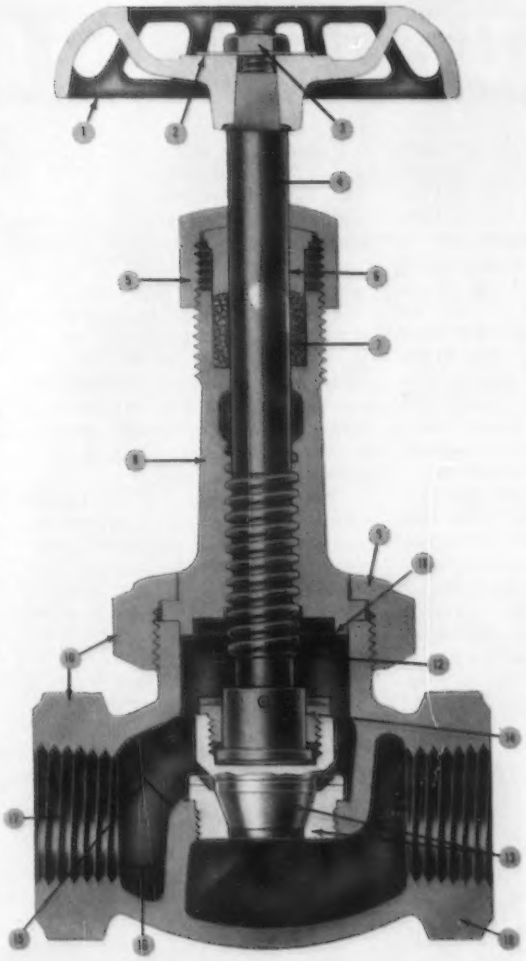

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OPERATING IDEAS

RIBBED ALUMINUM siding and corrugated aluminum roofing virtually makes this a maintenance-free structure.

EASY-TO-ERECT fireproofed columns and pre-assembled trusses constitute the frame of this low-cost industrial building.

A Fireproof Maintenance-Free Wood Frame Building

WHEN CROSS, AUSTIN & IRELAND Lumber Co. of Brooklyn, N.Y., designed the building shown above they had two objectives in mind: (1) The building must be completely fireproof, and (2) the building must require no maintenance. Fireproofed wood was chosen for the trusses because it will not buckle and collapse as steel will when exposed to sustained high heat (1300 to 1700° F.) Chemicals used to treat the wood under pressure were ammonium salts and boron compounds.

At a recent press conference, model wood buildings were filled with excelsior and ignited. Those which had been flameproofed survived the blaze with only a skin coating of char, while those which were untreated were completely consumed by flames. Fireproofing proved so effective that the insurance rate for the new building was set at $1.05 per $1,000, whereas the rate for a structural steel building on the same site was $1.15 per $1,000.

The building was roofed with corrugated aluminum supplied by Aluminum Co. of America, and sheathed with spruce-green enameled ribbon aluminum siding (Alumalure.) Aluminum was chosen because it will require virtually no maintenance.

This type of building is admirably suited to mine plant construction, particularly in areas where timber is readily available. The fireproofing technique might be used to treat mine timbers and wood to be used for construction near the portal of a mine, or in underground structures.

Cross, Austin & Ireland's treating solution is prepared in a 5,000-gal steel tank equipped with steam coils plus a centrifugal pump for circulation. Mixing is not difficult—all the chemicals are soluble in water. Heating, however, makes it easier to dissolve the boron compounds.

After the coils heat tank water to 130-140°F, chemicals are dumped in from the top and then agitated. The treating solution is stored in three upright cylindrical steel tanks, each holding 25,000 gal.

Actual treating is done in a horizontal 6 x 75-ft steel cylinder which has a ¾-in. wall and a hydraulically operated quick closing door at the front end. Motorized winch pulls loaded trams into the treating cylinder on a narrow gage track. Aside from loading and unloading, which calls for extra help, a single operator can run the entire treating plant.

After the unit's end door is locked, a vacuum is produced inside the cylinder to de-aerate the wood. (26 to 27 in. of mercury for about an hour).

While the cylinder is still under vacuum, 11,000 to 12,000 gal of the treating solution are pumped into it during a 10-minute operation. High-capacity centrifugal pump handling 600 to 700 gpm through 6-in. lines fills and empties the treating cylinder. Since the wood does not take up individual chemicals selectively from the treating solution, excess solution remaining after treatment can be recycled to the storage tanks to be used again.

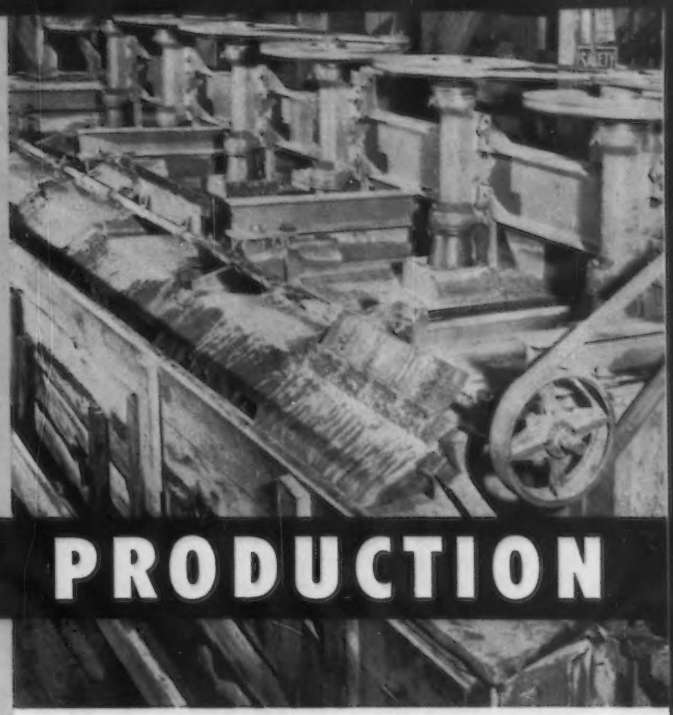
Once the cylinder has been filled, more solution is pumped into it. Since the water solution of the treating chemicals is essentially incompressible, the only place the solution can go is into the wood. Pumping in the additional solution builds up a hydrostatic pressure of 50 to 250 psi.

For any given treatment, the length of time in the cylinder and pressure involved depends on the characteristics of the lumber and the desired level of chemical impregnation. For soft woods, the average treating time is usually from 12 to 14 hours. Lumber can be left in the treating solution overnight and longer if necessary.

AFTER LUMBER is put into 75-ft cylinder and given a 10-minute bath with 11,000 to 12,000 gal of treating solution, it becomes as fire-resistant as the left model.

DENVER

"Sub-A" FLOTATION
is specified for



SILICA SAND PRODUCTION

By Major Glass Sand Preparation Plants

When iron stains, clay and middling particles make good sand hard to sell, call on DENVER'S experience. DENVER "Sub-A" Flotation Machines are extensively used for producing a low iron glass sand—suitable even for optical requirements. Silica sand plants using DENVER equipment are so successful that new plants and expansions specify "DENVER." You get the flotation selectivity necessary and DENVER machines are constructed to withstand the corrosive pulp conditions (acid circuits) normally encountered and also the abrasive action of the coarse, granular, slime-free washed sand. Operation is simple, profitable!

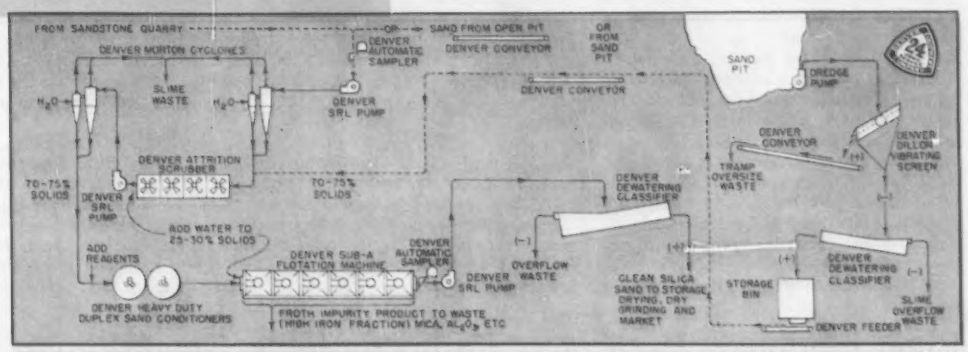
Your Sand Production Profits Begin with Reliable

DENVER LABORATORY TEST SERVICE

. . . your best insurance!

Your sand can be tested in our laboratory. Eliminates costly trial and error methods of perfecting flowsheet for specialized glass sand circuits. Takes the guesswork out of a big investment because you prove in advance you can do what needs to be done—that your sand can be produced at a profit. DENVER Laboratory Tests provide complete batch and continuous test data, flowsheets, reagent combinations, as well as description and size of equipment to produce desired tonnage at highest profits. Write to us for our recommendations. Shipping tags for sample sent on request.

TYPICAL FLOWSHEET FOR SILICA SAND PRODUCTION



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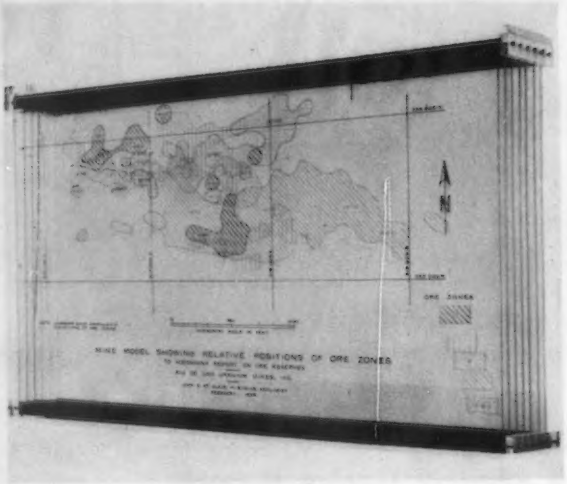
OPERATING IDEAS *(Continued)*

Ore Zones Stand Out Clearly On Three-Dimensional Model

A THREE-DIMENSIONAL view of the relative positions of ore zones can be gotten with a collapsible plastic mine model, according to John Q. St. Clair, consulting engineer, San Juan, Puerto Rico.

The 6x10x1½-in. model consists of nine pieces of 1/16-in. plexiglas (9¾x5¾ in.), mounted with small screws on four plexiglas end pieces (1½x5 5/16x⅛ in.). End pieces are in turn attached with countersunk machine screws to two side pieces (1½x10x⅛ in.).

Mr. St Clair said that geologic detail for each mine level is lettered on thin plexiglas sheets which are then mounted onto the 1/16-in. plexiglas plate by strips of adhesive tape (black bands in photo).



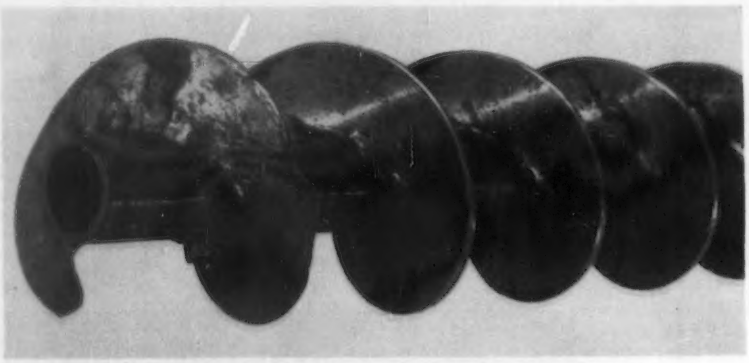
Tungsten Carbide Hard-Facing Greatly Increases Auger Life

TUNGSTEN CARBIDE HARD-FACING is increasing the life of bugduster augers on coal cutting machines by more than six times at the Belmont Fuel Co., Hunkers, Pa.

According to a release from Kennametal Inc., the auger's discharge end is the area of greatest wear. The augers (which eject fine coal cuttings from the side of the machine) are usually turned end for end after one becomes badly worn. The best auger material for this abrasive wear had to be changed after about five weeks of service.

Auger ends were then hard faced with a tungsten carbide material developed by Kennametal. The company said that "the hard facing material incorporates a form of carbide and range of sizes that enable exceeding former standards of wear resistance in hard facing materials, including common forms of the carbide used for this purpose. Known as KT-80 Tube Kenface, it has an approximate ratio of 60% carbide to 40% steel in the tubes".

Alloy Hard-Facing Co., Greensburg, Pa., did the actual auger operations, using standard procedure with oxy-acetylene torch. The deposit was put on the edge of the helical blade and a pressure face 180° from the discharge end. The cleaned surface on the end of the auger was heated to a sweat and the Kanface tube was melted onto the surface with an acetylene-rich 2½X to 3X, reducing flame.



AT THE END of 32 weeks of wear, the blade section behind the hard-facing became notched. As a result, hard-facing was placed on more than a 180°-section.

Very little wear was apparent on the Kanface at the end of 32 weeks. Beyond the hard-faced are, however, where wear had not previously been a problem, notching indicated that Kenface should be extended more than 180° along the edge of the helical blade.

Plant Engineers Use Epoxy Resins to Solve Tough Repair Problems

FOR THE PAST THREE MONTHS, engineers at Climax Molybdenum Co., Climax, Colo., have been running a variety of tests on several of the epoxy resins.

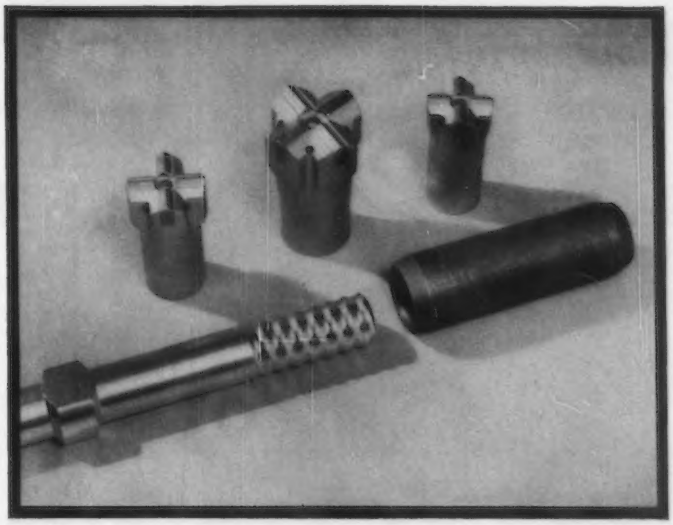
The following results appeared in the September 22 edition of Moly Mountain News:

• In one of the early tests, a concrete test block was formed and poured. When completely cured, it was broken and the two sections put together with epoxy resin. Again, the "stick" was put under strain and broken. This time, the break occurred in previously unbroken concrete, indicating that the glued joint was stronger than the original material. The process was repeated a number of times with the same results.

• The mill department was making repairs on one of the pebble mills in the regrind plant. One of the mill heads to which the end liners are bolted was very badly worn, and would normally have been scrapped.

When consulted, concrete engineer Joe Nurneke said that he would like to try repairing the head with an epoxy resin. First of all, the head had to be built up to original thickness with a metalized aggregation consisting of one part Portland cement and two parts Embeco. To ensure a reliable bond between the parent metal and the metal aggregate, the parent metal was coated with epoxy resin.

Results indicate that the structural strength of the mill head has been regained and it is now back in operation for the final "inservice" test. Assuming that the test will prove the worth of the process, a saving of many dollars will be realized.



Here's proof Coromant rope-thread bits and steels SAVE TIME AND MONEY

"Up to double the footage between sharpenings!"
"Premature rod breakage is almost non-existent!"
"40% more usable life—more resharpenings!"
"Bit and rod life are well above average!"
"Uncouple by hand all the time!"
"More rigid—drills straighter holes!"*

**Names of men quoted available on request*

The comments above are actual quotes from project managers, job superintendents, and drill superintendents who have tested new Coromant rope-thread bits and steels. They've learned, on-the-job, the benefits they—and you—can expect!

For example: The new rope-thread (only two turns per inch) holds tight in use, yet permits hand uncoupling. Reports show that the time saved results in more footage drilled per shift. Bit footage is well above average too, with less loss of carbide inserts. Prime quality ore plus nickel-chrome alloy permits cold-rolling from billets for greater strength, life and rigidity. And only with Coromant rope-thread steels can you re-thread without heat treating, too. Do it yourself, or at any nearby machine shop.

Want to know more? There's no obligation on your part, but we'll be glad to help where we can. Just call your nearest Atlas Copco Office, or write to us at Dept. EMJ-7.

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Mining Practice, Processes & Patents

A roundup on what's being written and said, the patents granted, the techniques tried in the mines, mills and smelters.

Donald MacLeod, metallurgical superintendent, Mindola mill, Rhokana Corp.

J. P. Kearney, former concentrator superintendent; and **Jack MacDonald**

Lou Harris, plant metallurgist; and **Sam Featherstone,** senior metallurgist

Rhokana Corp. Switches To Rod Milling

LOOKING TO FUTURE expanded output of the Mindola shaft and urged on by an economy drive, Rhokana Corp. switched from ball milling to rod milling at the Mindola concentrator without a let-up in production according to Dr. J. P. Kearney, concentrator superintendent, in a recent issue of the RHOKANA REVIEW. During 1956-57 Rhokana's monthly milling rate was about 350,000 and it was decided to expand the rate to 400,000 in 1958. A study showed that the crushing plant was a serious bottleneck which would require extensive expansion.

The metallurgical staff decided to convert the ball mills to rod mills and eliminate the tertiary crushers and the screening plant from the circuit—seven crushers and 16 double-deck screens could be removed.

All plans were co-ordinated with equipment to arrive, be assembled and installed on a time-table schedule. The 8-ft dia mills were torn down, one at a time, new precast foundations installed, the 12-ft dia rod mills remounted and put back in operation. Change from an old to a new mill took seven days from shut-down to start-up. At the same time, Rhokana made several other important changes in the mill. One was to install wet cyclones in place of the mechanical classifiers. Another was to install roller bearings on the new rod mills in place of the old white-metal bearings. This meant that the mills could be enlarged from the 8 to 12 ft size without changing the size of the motors used to drive the mills.

Another improvement is that there is no need to run the screening plant and thus contamination of the ventilation air being sucked down Central shaft near the screening plant was reduced.

Twelve Direct Reduction Patents

Low-Carbon Iron in One Step

A SINGLE-STAGE reduction process that yields low-carbon pig iron from any type of ore, without the use of coke, has been patented by F. G. Pearce and Pan American Petroleum Corp. (Canadian No. 579,669). In the process, an ore-flux charge is reduced to metal and slag with carbon monoxide, hydrogen and oxygen. Molten pig iron, according to Pearce, is suitable for hot metal use.

R-N Process Treats Taconites

LATEST PATENT granted to the R-N Corp. (Canadian No. 579,670) particularly specifies that the process is designed to produce reduced or partially reduced iron from taconites. Process employs a countercurrent heat exchanger setup to gain considerable heat economy—ore is smelted with a solid carbonaceous material such as a char (see below) and a non-coking coal, and the reduced product contacted with a high-volatile coal, volatilizing the hydrocarbons from the coal, which form the process fuel, and leaving behind a char which is used as a reducing agent (above). Work was the result of efforts by R. P. Smith and D. E. Babcock.

Another recent Canadian direct reduction process patent is that granted to F. B. Sellers and P. L. Paull and assigned to Texaco Development Corp. with Canadian patent No. 579,782. Carbon monoxide and hydrogen are used as reducing agents.

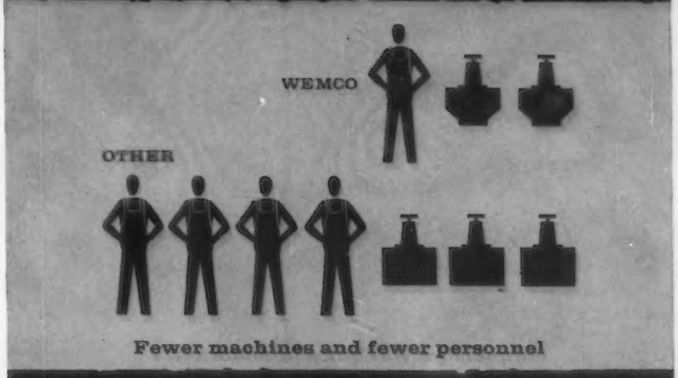
Batch Fluid-Bed For Fines

A PROCESS and apparatus whereby iron ore fines can be smelted without agglomeration is described in British patent No. 814,684. E. Lubatti, patentee, states that ore, flux and fuel are charged into the furnace in a bed 0.8 to 1.8 meters deep, then air, preheated to 700° C, is admitted up through the bed in three different places.

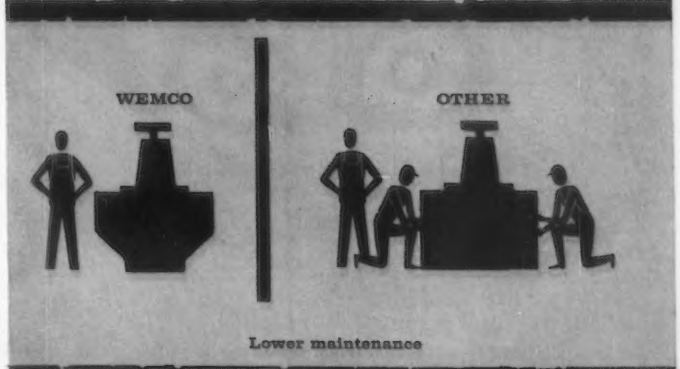
German Oxygen Process

PROPER proportioning of the carbon dioxide and oxygen supplied by the air blast to a blast furnace results in considerable fuel savings according to Ruhrstahl, A.G., which has been

LABOR REQUIREMENTS REDUCED, MAINTENANCE COSTS CUT... WITH WEMCO-FAGERGREN FLOTATION



Fewer machines and fewer personnel



Lower maintenance

Wemco-Fagergren equipment costs less, *much* less, to operate! Operating labor is reduced because Fags need little or no adjustment to compensate for feed variations. Simplicity of design and operation assures fewer maintenance problems—and less cost. There is less wear and replacement of parts, less downtime because wear-exposed parts are rubber covered and an entire mechanism is easily removed for inspection and repair without shutdown of pulp flow.

This proved economy plus greater recovery adds up to consistent, profitable operation under the most demanding conditions! If flotation will do the job, Wemco-Fagergrens will do the job better, at less cost! Ask for complete information.

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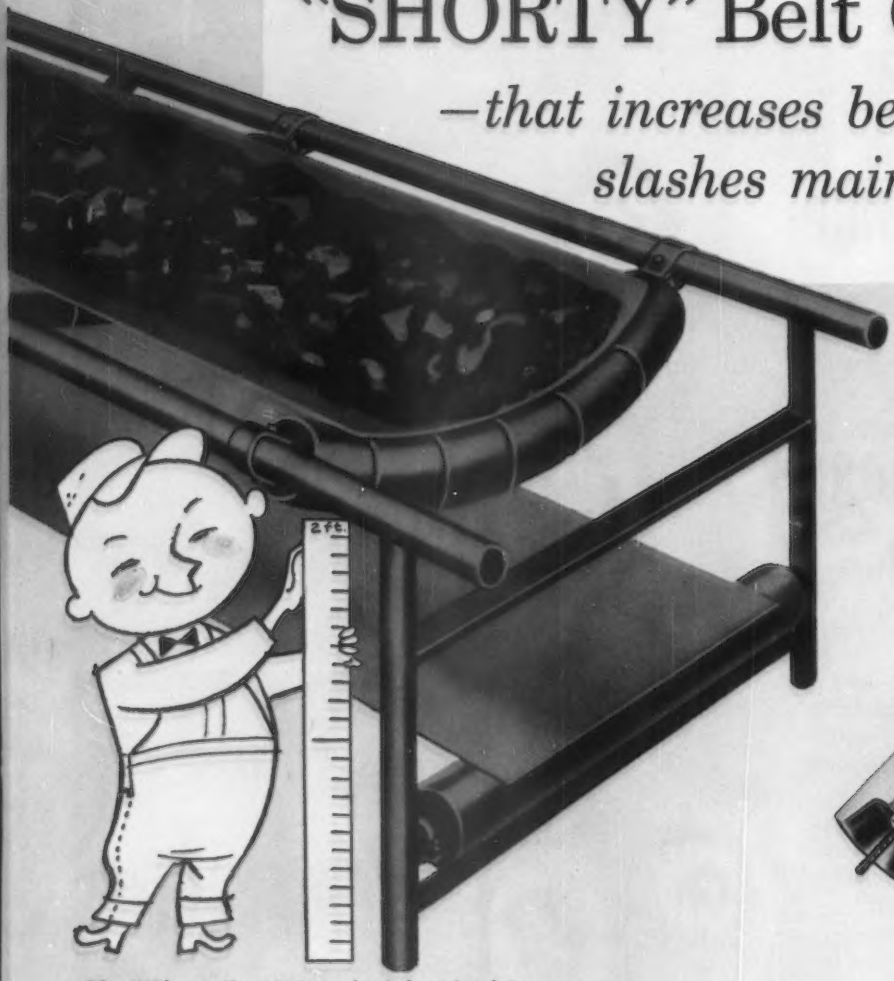
See the NEW McNally Pittsburg "SHORTY" Belt Conveyor

—that increases belt life, slashes maintenance cost!



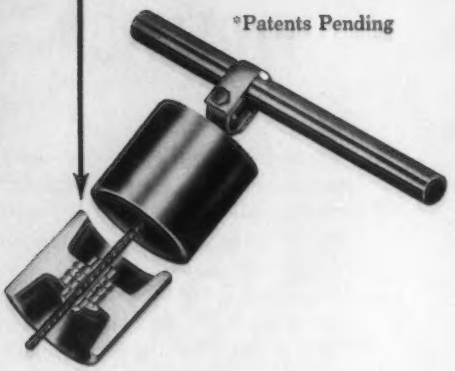
The "Shorty" unit is only 2 feet high!

The new "Shorty" underground conveyor featuring the new McNally Pittsburg Cradle Idler is ideally suited for use in limited working areas. Vertical supports are only 2 feet high. For extremely low clearance installations these conveyors can be made with 3″ diameter rollers (instead of the standard 5″), and the average over-all height can be as little as 17″ for a 36″ belt, using a 30° deep trough idler construction.

For "Do-it-yourself" construction, the H-frames and stringers (which may be either wire rope or pipe stringers) are shipped disassembled and may be assembled in the field to fit any conveyor length necessary. It is only necessary to cut the stringers to the desired length, attach the Cradle Idlers and H-frames, and your conveyors are ready for operation.

Exclusive NEW Patented Cradle Idler*

*Patents Pending



The secret of the dramatically improved performance and lower maintenance cost of this new heavy duty conveyor is the *true catenary suspension* of the Cradle Idlers. Since the rollers *rotate* on the steel rope, dangerous "loping and harmonics" cannot develop. The 5″ rubber rollers, assembled on precision ground ball bearings, are prelubricated, lifetime sealed.

- Increased belt life—because full belt support is maintained under all conditions
- No creasing or cutting of belt
- Minimum maintenance

McNally Pittsburg Mfg. Corp., Pittsburg, Kansas

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☐ Have Sales Engineer call for further consultation.

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MANUFACTURERS OF EQUIPMENT TO MAKE COAL A BETTER FUEL

McNally Pittsburg Manufacturing Corporation—Manufacturing Plants: Pittsburg, Kansas • Wellston, Ohio • Engineering and Sales Offices: Pittsburgh • Chicago Rio de Janeiro • Pittsburg, Kansas • Wellston, Ohio

granted a British patent (No. 815,112 on the method and idea of supplying air that contains 21 to 36% oxygen and a ratio of CO_2:O within the range of 1:2½ and 1:4.

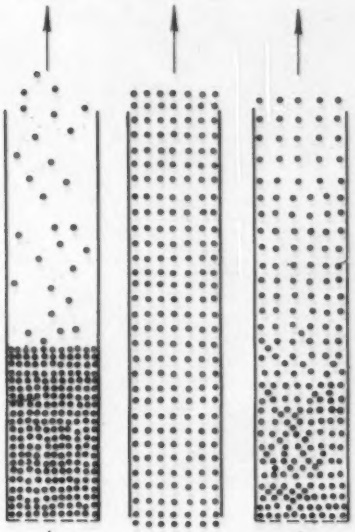


Fig. 1 (old art) *Fig. 2* (old art) *Fig. 3*

High-Velocity Fluid-Bed

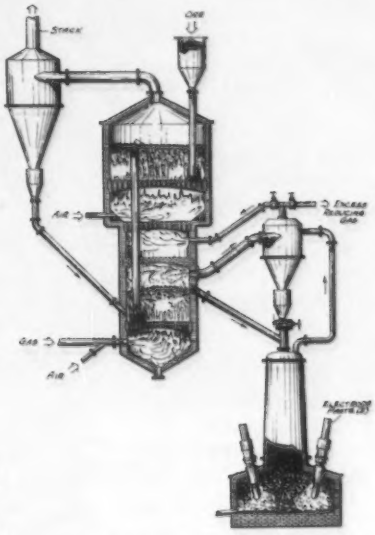
ACCORDING to Franz Schytil, Metallgesellschaft, Aktiengesellschaft, Frankfurt am Main, Germany, his newly-patented fluidized reactor for exothermic materials can produce one ton of roasted product per hour containing as little as 1.3% S from pyrite (38% S)—the reactor is only 4 meters high and 1 sq meter in cross section. High air rates (two tons per hour) and the use of dry cylones to recycle the roaster product in part or whole to get desired reaction, are two key points in the patent (U.S. No. 2,893,839). Schytil claims that in a properly designed fluid bed reactor, the concentration of the solids should range from 30% at the feed end to as little as 10% at the discharge point. Such a high degree of dilution is the reason Schytil can reach his high temperatures. Exit gases from the product cyclones were reported at 10% S and 1,000° C.

Three New U.S. Methods

HYDROCARBON RESEARCH INC.'S patent involves the use of solid reducing agents in addition to the pure hydrogen to affect reduction. Patent No. 2,900,246, granted to P. C. Keith and H. N. Woebcke, states that the solid fuels minimize agglomeration of the fine ore.

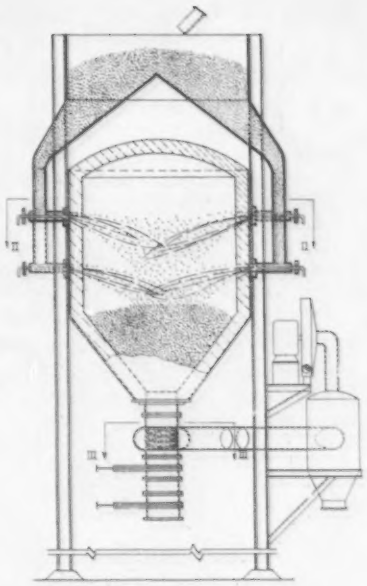
Hydrogen and carbon dioxide are used in the sponge iron process patented by J. Celada of Fierro Esponja, Monterrey, Mexico. See E&MJ, October 1958, p 150 for details about this batch process which has been licensed to M. W. Kellogg. Patent No. is 2,900,247.

An improved method is described in U.S. Patent No. 2,900,248 for feeding and controlling the oxygen-containing reducing gases in the Krupp-Renn Process. Method results in lower process fuel requirements, better size and shape of finished nodules. For details of several of the direct reduction processes mentioned here, see E&MJ December 1957.



Reactor Feeds Furnace

WHERE CHEAP natural gas (or other hydrocarbons) and cheap electricity are available, the fluidized bed-electric furnace combination patented by Bruce S. Old and Richard W. Hyde (U.S. No. 2,894,831) offers another means of getting around the lack of suitable metallurgical coke supplies. Other advantages of the process are that it is economical in comparison with a blast furnace, has large capacity in a single unit (no multiple unit problems) and offers several important heat saving features. One is that the fluidizing air and reducing gases are preheated. Another is that the hot product goes directly into the electric furnace without too much loss of heat content (and protected from the atmosphere to prevent re-oxidation). Process requires no additional preparation of the reduced iron such as extrusion, briquetting or agglomeration. Old and Hyde claim that a 20-ft dia reactor and an 18,000-kva electric furnace can turn out 500 tpd of good quality pig iron using a high-quality iron ore.



Downdraft Moving Bed

HEATING, reduction or roasting can be performed economically and efficiently according to W. A. Patterson (U.S. Patent No. 2,892,698) in his apparatus shown here which provides a preheater for the ground feed, a means of injecting the feed and solid fuel into the furnace in a fluidized state so that the feed is heated to the desired temperature rapidly. Chemical change takes place in the quiescent mass held in the bottom of the reactor through which the furnace gases are drawn, providing an effective re-use of the carbon monoxide produced by the combustion of the fuel in the fluidized section.

Inland Steel's Moving Bed

DIRECT REDUCTION of iron ore is accomplished with a CO-enriched gas and any H_2 present from the enriching system in Inland Steel Co.'s process according to U.S. Patent No. 2,889,219 granted to James W. Halley. In the process, iron ore is reduced in a downward moving bed reaction with updraft CO-gas reducing the oxide to metal. Then the reduced iron is screw-fed into the smelting hearth where it is converted into molten iron and slag through the addition and reaction with oxygen-enriched air, fuel (coal or gas) and slagging agents, if any needed. Off-gases from the smelting hearth, being high in CO_2, must be reformed and reduced to CO by reaction with carbon before being fed into the moving bed reactor. Again, like the Old-Hyde patent (left), the reduced iron is kept away from the atmosphere and fed into the smelter while still hot.

Anglo American Seeks Process For Sandstone

KEEN INTEREST and much speculation centers around Anglo American Corp.'s brief announcement that the metallurgical research staff is working hard to find a suitable and economical process for recovering copper from banded sandstone overlying the main orebody at Nchanga mine. Deposits are said to be colossal in size, but run only 1 to 1.5% Cu. Sir Harry Oppenheimer, board chairman, reveals that work to date has been encouraging. Nchanga's present mineable reserves are listed at 167-million tons.

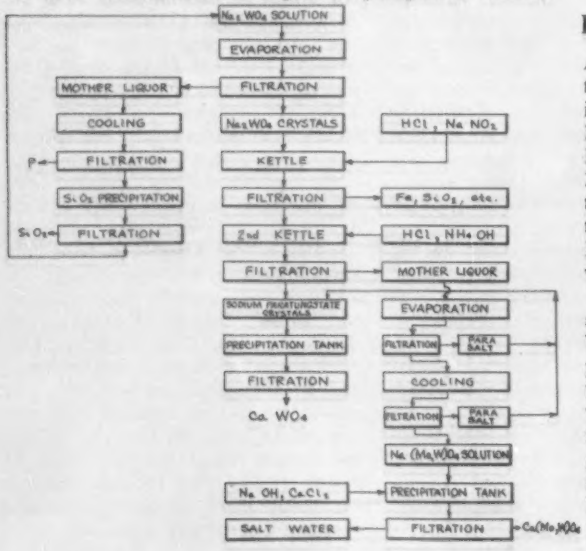
Slime Flotation Increases Lead Reserves

A SLIME FLOTATION process method developed by the U.S. Bureau of Mines while conducting mineral dressing research on lead tailing slime from St. Joseph Lead Co., Bonne Terre, Mo. mill may greatly augment existing lead reserves. Results show that on a feed material assaying 0.20% Pb and 70% finer than 400 mesh, a recovery of up to 45% could be obtained by flotation in a rougher concentrate assaying up to 6.5% Pb.

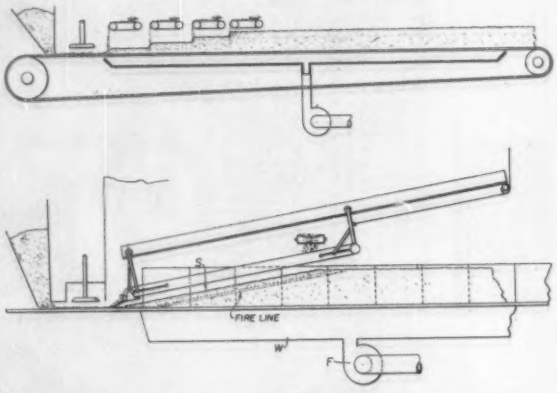
Sodium sulphide was beneficial in floating the free, finely divided galena. Reagents were large quantities of xanthate and a frother. Nothing spectacular is contained in the method, but it is obvious that a substantial saving could be made, according to the Bureau, by lowering the mill tailings further at existing mills. Preconcentration in a wet cyclone improved the Pb content of the cell feed. Work was done by D. W. Frommer and M. M. Fine in R. I. 5444.

Caustic and pH Control Purify Tungstates

TO PROVIDE A SIMPLE, effective and economical means of separating phosphorus and arsenic from an alkali metal tungstate solution, Pai Yen Loung, of Wah Chang Corp., New York, N.Y., developed and patented (U.S. No. 2,893,832) this simple approach—prepare the alkali metal tungstate (0.4% to 4% alkali metal hydroxide concentration); evaporate it while at low pH value to reduce solution volume and raise tungstate concentration; raise pH to the 12 to 14 range; heat the solution and while still hot, filter to recover sodium tungstate (Na_2WO_4) crystals. By repeating the process four more times, Loung produced five different grades of tungstate—the first being the purest and the last the most contaminated in regard to phosphorus content.



Second patent granted to Loung (U.S. No. 2,894,814) is considerably more involved and concerns the removal of molybdenum, phosphorus, arsenic and other impurities by a complex recrystallization of an alkali paratungstate from normal alkali metal tungstate crystals. Flowsheet is shown below. Earlier methods involving the removal of impurities by crystallization of ammonium paratungstate were only half successful—the best yield being 40 to 50% low-molybdenum product. Hot filtration and pH control to remove phosphorus and other impurities is also claimed in this second patent. In test to remove molybdenum, Loung started with 0.53% Mo ammonium paratungstate and ended up with purified sodium paratungstate containing only 0.07% Mo—86% of the Mo stayed in the mother liquor.



Reciprocating Conveyor Feeds Sinter Strand

TO GET AROUND many of the obvious disadvantages of feeding a sintering strand with a multiple series of conveyor feeders, R. C. McDowell (McDowell Co., Inc.) has developed a mono-layer system of feeding. Upper drawing (above) from his patent application shows the normal method of layer feeding a strand. Lower drawing illustrates his feed conveyor which reciprocates fore and aft to build a deep-bed charge on the traveling grates. Advantages: fewer feeders, much less drop and damage to green pellets, less segregation of large and small pellets, fewer compacted masses of green balls, uniform control over the feed rate, lower heat loss around the sintering hearth hood and better sintering.

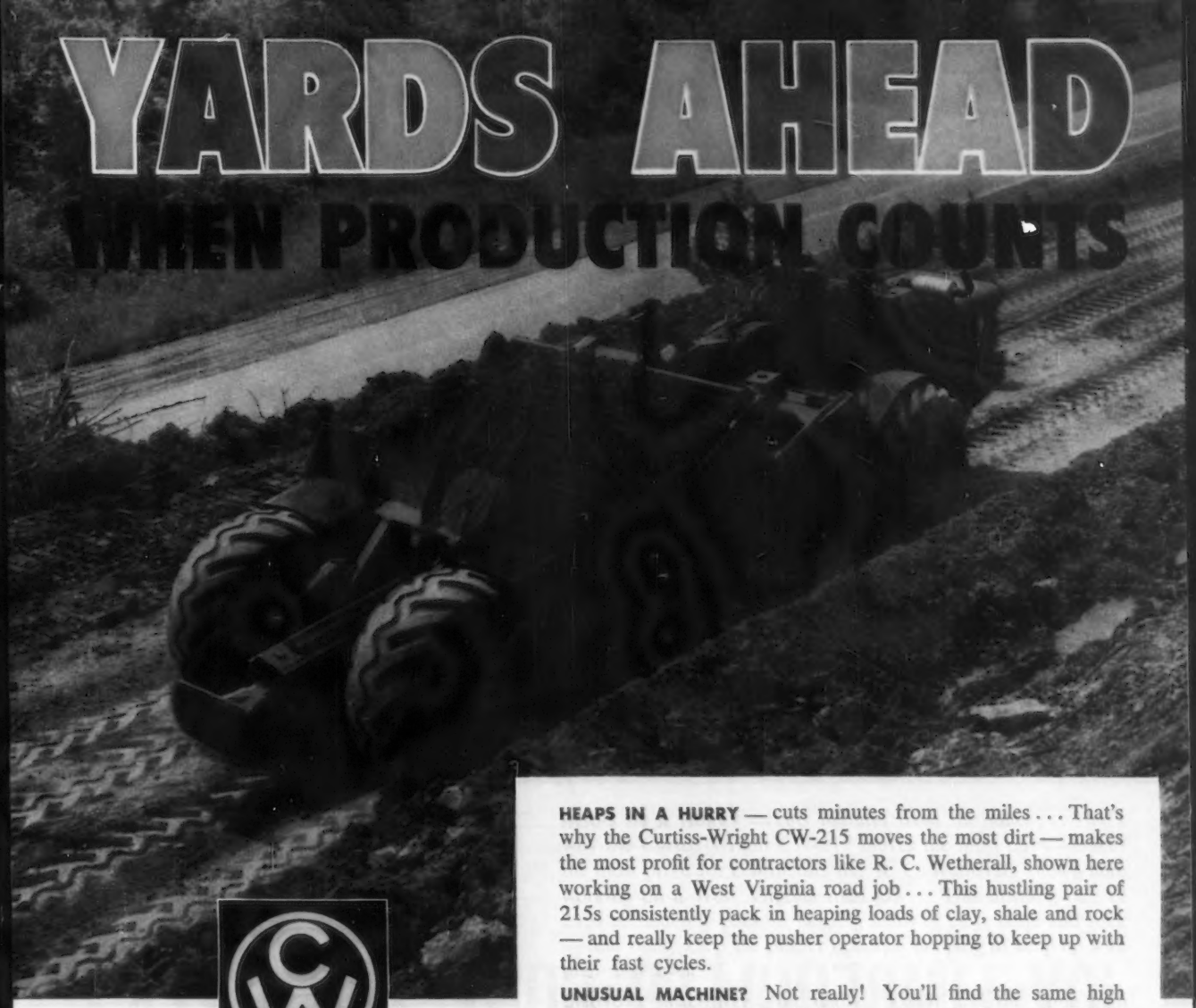
Blowing to Flat Copper in the Converter

A PROCESS that departs from conventional copper refining techniques in that further refining beyond the blister stage is done right in the converter has been patented by Eugene R. Redmond, Brian Jackson Associates, Inc., Tucson, Ariz. In the Redmond Process, the copper is blown at about 2,150° F through the worm stage until the worm is about to leave the copper, at which time the copper is substantially saturated with oxygen and copper oxide. At this point, Redmond adds a silica flux, 2 to 5% by weight of converter charge.

Blowing continues for as long as needed to produce a flat copper—about five minutes on a 70- to 80-ton charge. When the slag has solidified, the purified copper can be poured and cast into anodes. Redmond gives several ways to determine the worm-out and flat-copper end points. Advantages to the process are fewer steps, finer product, and that it is much quicker than present industry practices of going by ladle to a second unit for blowing past the blister stage (at higher temperatures, to 2,600). Slag losses are lower, converter lining losses are negligible and the production cost is lower according to patent No. 2,895,821.

Bearing Location is the Key to Long Service Life

YARDS AHEAD
WHEN PRODUCTION COUNTS



HEAPS IN A HURRY — cuts minutes from the miles . . . That's why the Curtiss-Wright CW-215 moves the most dirt — makes the most profit for contractors like R. C. Wetherall, shown here working on a West Virginia road job . . . This hustling pair of 215s consistently pack in heaping loads of clay, shale and rock — and really keep the pusher operator hopping to keep up with their fast cycles.

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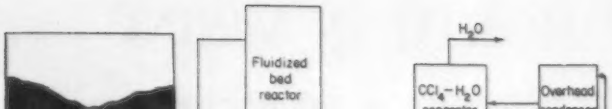
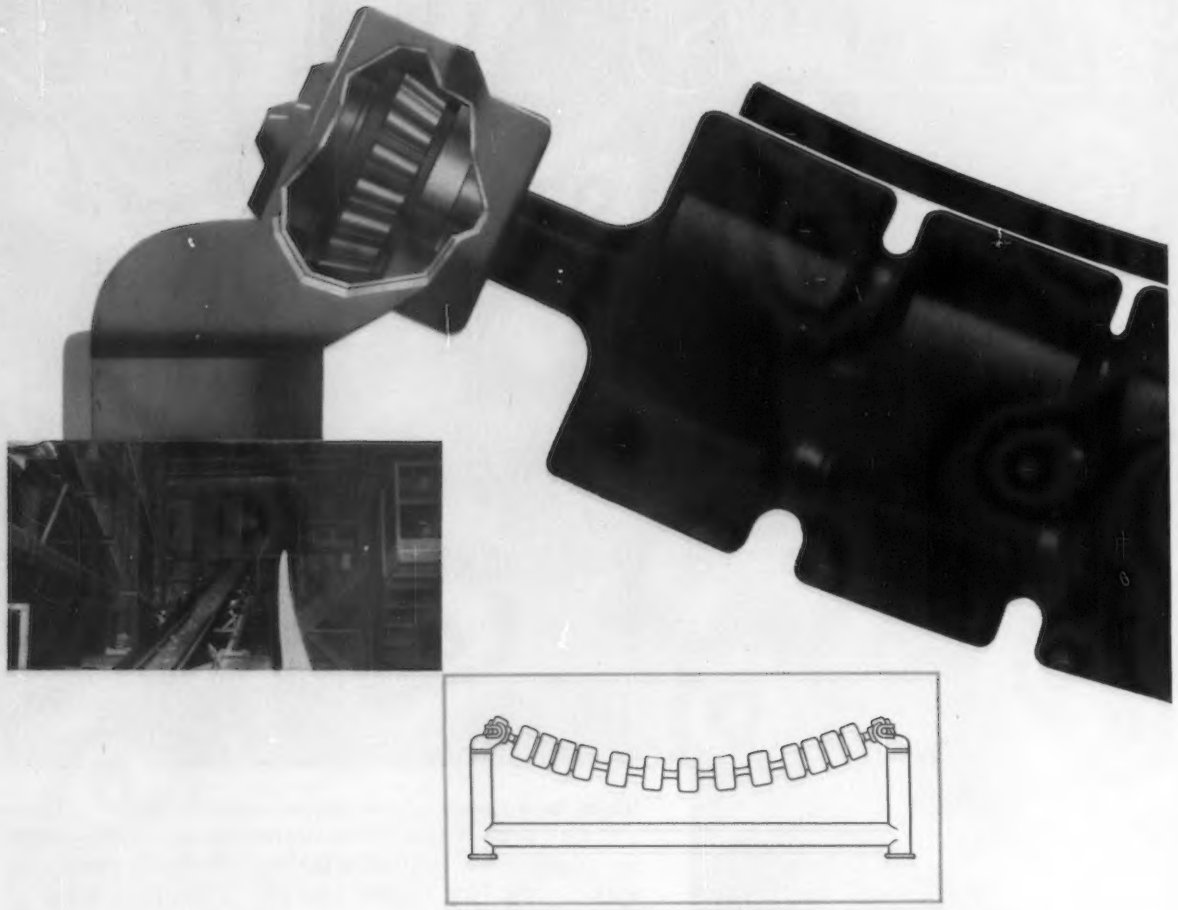
Practice & Process *(Continued)*



Bearing Location is the Key to Long Service Life



JOY LIMBEROLLER® CONVEYOR IDLERS

Joy Limberoller Conveyor Idlers give many times the normal service life, because the two bearings rest in slots in the support brackets—well away from spillage. On conveyor lines carrying ore, crushed rock, and other abrasive materials, Limberollers have given more than ten times the service life of steel idlers.

Limberoller Idlers consist of a neoprene coated wire rope to which are moulded neoprene discs. The ends of the rope turn in sealed bearings. This design not only eliminates clogging and freezing of the bearings, but also makes the idlers easy to service—they can be replaced while the belt is moving.

Limberollers are economical, not only because of long service life, but also because they can be spaced further apart than steel idlers. They are corrosion and flame resistant, self-cleaning, and eliminate the "bump" typical of steel idlers.

For complete details, write for Bulletin 358-4.

EQUIPMENT FOR MINING... FOR ALL INDUSTRY

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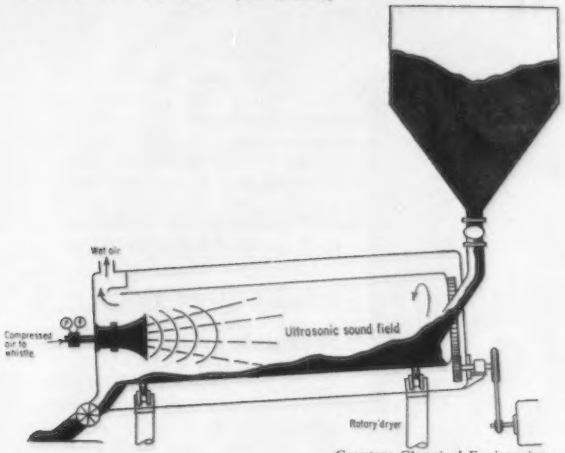
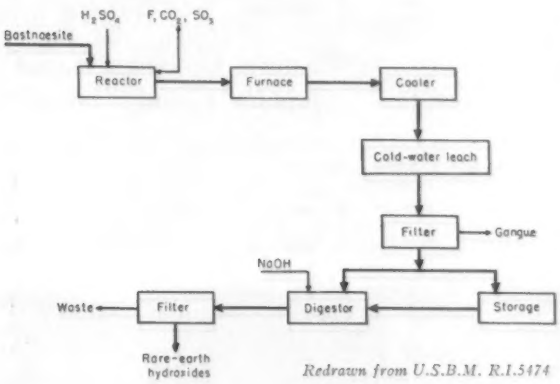
In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario



Courtesy Chemical Engineering

Solving a Tough Drying Problem

ULTRASONICS are being applied, according to R. M. G. Boucher, Research Div., New York University in CHEMICAL ENGINEERING, Sept. 21, 1959, pp 151-154, to solving difficult drying problems. Method can be used on either conveyor or rotary kiln type dryers in either vacuum or draft pressure systems. An ultrasonic force creates much more surface area on the particles being dried and does it many thousands of times a minute. It also creates an oscillating vacuum at the same time, which further aids in the drying.

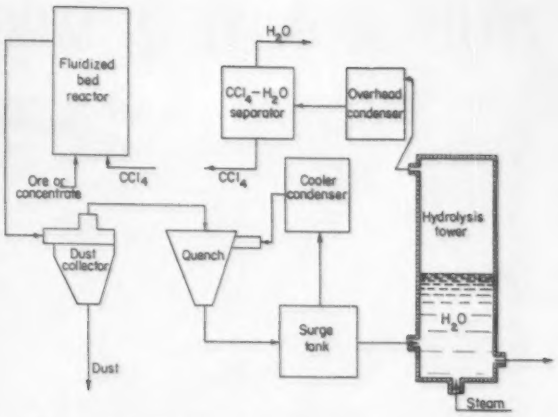


Redrawn from U.S.B.M. R.I.5474

Bastnaesite Yields to Sulphuric Acid

A SIMPLE and effective method has been developed for extracting the rare earth compounds from bastnaesite, a natural rare earth fluorcarbonate found in large quantities at Mountain Pass, Calif. As part of the broad U.S. Dept. of Interior study on the rare earths, the Bureau of Mines developed the method shown in the flowsheet above and reported the findings in REPORT OF INVESTIGATION 5474, "Extraction of Rare Earth Elements from Bastnaesite Concentrates," written by Van E. Shaw.

The Mountain Pass deposit, owned by Molybdenum Corp. of America, is the world's largest known deposit, assaying about 10% rare earth oxides. The process described by Mr. Shaw digests the flotation concentrate with sulphuric acid, converting the fluorcarbonates to sulphates, releasing the fluorine and silicon (and the carbonate). The sulphate slurry after dewatering is calcined at 1200 deg F, rendering the gangue insoluble while the rare earth sulphates remain in their water-soluble form.



Carbon Tetrachloride Extracts Columbium

RECENTLY Nova Beaucage Ltd., North Bay, Ont., a subsidiary of Consolidated Mining & Smelting Co. Ltd., announced the development of a successful flotation process for concentrating columbium. Now, in the past two months, Nova Beaucage has received a patent on a columbium extracting process which uses carbon tetrachloride as the chlorinating and extracting agent, then uses cooled carbon tet as the means of condensing the chloride vapors. The separation of the columbium chlorides from the carbon tetrachloride is made by simply contacting the solvent with water heated to above the boiling point of the carbon tet, according to U.S. Patent No. 2,905,545.

Additional Patents Briefly Noted

U.S. Patents Just Released

Gamma ray aerial survey (P. R. Mulligan) 2,904,691
Transferring green pellets (G. H. Sundin) 2,902,143
Ether solvent extraction of uranium (C. D. Harrington, assigned to the U.S. AEC) 2,903,331
Pelletizing and leaching titaniferous ores (R. D. Pike, held by K. B. Ray and Stamford Trust Co.) 2,903,341
HF leaches silicate from ilmenite (E. J. Michal, assigned to National Lead Co.) 2,904,177
Charging shaft pelletizing furnaces (Anderson) 2,904,195
Roasting and leaching chrome ore (F. Shubert) 2,904,396

These U.S. Patents Have Expired

Flotation of nonmetallics (American Cyanamid) ... 2,300,827
Debismuthizing lead (Y. E. Lebedeff, Asarco) 2,300,939
Floating nonmetallics with oleic acid, using castor oil to disperse the acid (Moeller and Wagner) .. 2,302,338
Mercury roaster (G. E. Connolly) 2,303,841

Recent Canadian Releases

Apparatus for determining the bearing of a diamond drill hole (V. Thompson) 580,586
Electrolytic production of uranium (R. R. Porter and E. T. Pinkney, assigned to Atomic Energy Board of the Union of South Africa) 580,614
Montecatini's aluminum pot cathode design 580,835
Direct reduction of iron ore (U.S. Steel) 580,869
Direct reduction of iron ore (Ford Motor) 580,922
Solvent extraction of uranium with TBP (U.S. AEC) 580,936
HF to liberate titanium (Allied Chemical Corp.) .. 580,962
Improvements in the nickel carbonyl process for ores containing a relatively high iron to nickel ratio (S. G. Townsend, assigned to Inco) 581,542
Texaco's instant oxide slurry leaching process (See E&MJ, October 1958, p 116) 581,553
Electrolytic cell additive for nickel (Inco) 581,778
Agglomerating chrome ore (J. H. Brennan) 582,019
Pelletizing method (W. E. Apuli, Univ. of Minn.) .. 582,056

THIS MONTH IN MINING (*Continued*)

THE FINAL SCORE is chalked up by Jim McAlpine of Vaal Reefs at the end of the one month's run on what will become one of the deepest shafts in the world.

South Africans Shatter Soviet Shaft Mark

THE WORLD shaft-sinking record, set up by the Russians in sinking the New Boutoff No. 3 Shaft at a Don coal mine, was decisively shattered by a South African team at Vaal Reef gold mine in the Western Transvaal Oct. 1.

The shaft-sinkers at the mine—one of the Anglo American group—had struck down 922 ft in 30 days. The Russians had captured the record from South Africa April 30 with a shaft of 868 ft in the same period.

The comparable statistics demonstrate in some degree the merit of the South African performance:

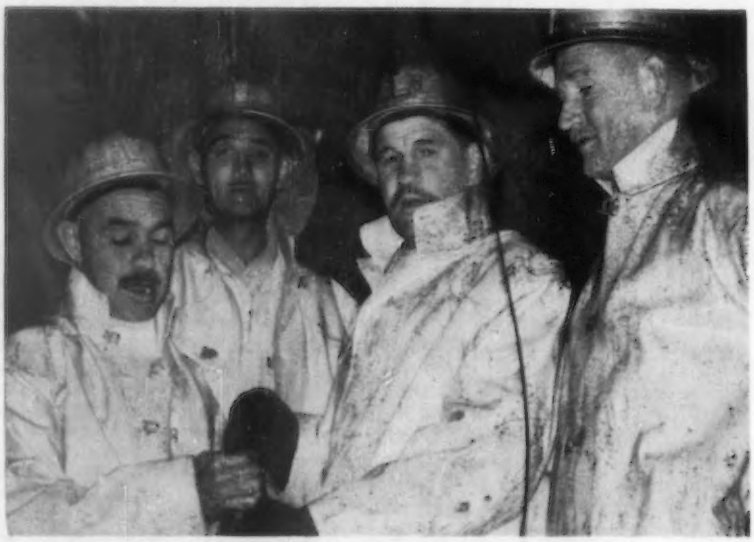
	Vaal Reefs No. 2 Shaft	New Boutoff No. 3 Shaft
Footage sunk in one month	922	868
Footage concrete lines	940	—
Total tonnage excavated	55,240	24,280
Excavated diameter	28ft.	21.65ft.

Final blasting charges in No. 2 shaft at the South African mine were exploded 30 seconds before 7 am Oct. 1. The Union flag flew strongly from the shaft-head as master sinker Jim MacAlpine proudly chalked up the new world record.

The giant drag and kibbles (buckets with 10-ton capacity) began clearing the blasted volcanic rock out of the shaft. The singing teams of stubby black laborers from the mountainous country of Basutoland scrambled to clear away the loose rock at the base of the shaft.

There was no stoppage then to celebrate the event, except for a few minutes for cigarettes and mugs of cold water on the spot. But the next day, MacAlpine and his working force of 48 Europeans and 353 negroes joined mine officials in a party—in between shifts. The work goes on and will continue for some time since No. 2 Shaft at Vaal Reef Mine is destined to become one of the deepest vertical shafts in the world.

The 30-day period was a day-and-night stretch of nerve-wracking, back-breaking toil. The shaft was advanced at an average of 7 ft a shift (there were four shifts of six hours ech day). The record distance advanced in one day was 39 ft. Improved hoist removal of the rubble after blasting is claimed to have been the prime factor in the creation of the new record. The new target for South African shaft-sinkers is 1,000 ft in 30 days. With new methods, speedier working and experience gained daily, they anticipate the attainment of this mark in the foreseeable future.



THE FINAL CHECK is made at 2,000 ft by surveyor P. Joubert, sinker G. J. Joubert, helper D. Coetzee and shaft foreman R. A. Waldeck on the 30th day.

Inland Steel Joins Wabush Iron Co. Ltd.

A 10% OWNERSHIP in Wabush Iron Co. Ltd., which has a pilot plant under construction at its mine in the Labrador iron ore trench, has been purchased by Inland Steel Co.

Wabush holds a long-term lease on the property from the Newfoundland government and plans an eventual 10-million tpy capacity at the site from the low grade, but easily amenable ore. A 37-mile rail connection to the QNS&LRR is expected to be completed in time to take initial shipments from the pilot plant.

Wabush plans initial output from the permanent facilities on the order of 4.5-million tons per year some time in 1965. Inland's subsidiary, Caland Ore Co., Ltd., is developing a mine at Steep Rock Lake, in Ontario.

Western Governors Okay Advisory Council Plans

GOVERNORS of the western states, over the lone dissent of Edmund Brown (D. Calif.) approved a program recommended by their minerals advisory council, at Sun Valley, Idaho, Sept. 26.

In first principle, it asks that at least

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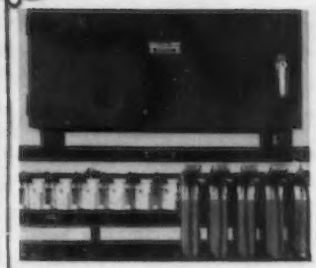

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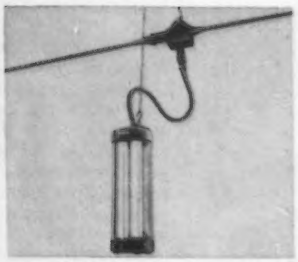

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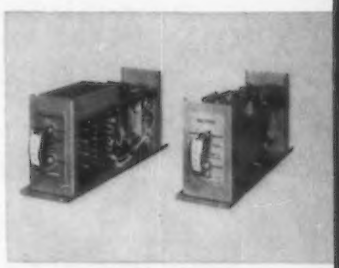

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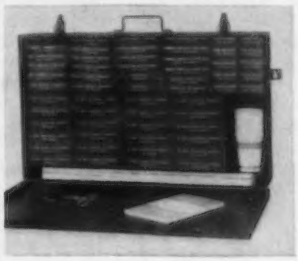

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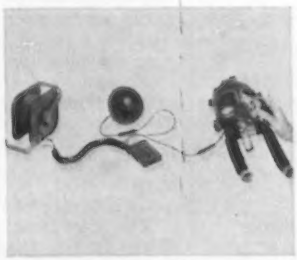

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Governors *(Continued)*

one-half of the domestic market be reserved for products of U.S. mines.

Various means of effecting this goal were outlined in terms of specific metals and involved tariffs, quotas, combined tariffs and quotas as well as plans similar to the wool program.

Gov. Brown said he objected to the program because of its "national and international" implications.

He favors continued loans and grants to backward nations for the stimulation of mineral production, he said and added that "two administrations had been unable to satisfy the mining industry".

It has been during the post World War II era that substantial losses in domestic markets has been suffered by U.S. mines.

Twelve other western governors approved, with minor changes the recommendations drafted by the council, of which S. H. Williston, Palo Alto, Calif., is out-going chairman. He is vice president of Cordero Mining Co.

Williston will be succeeded by Clark L. Wilson, vice president of New Park Mining Co., Salt Lake City, as chairman.

Gov. Paul Fannin (R. Ariz.) said that in "recognizing the conflict" between the recommendations of the western governors, "we ought to suggest that the U.S. State Department readmit the mining industry to the Union."

Gov. George D. Clyde (R. Utah) urged the approval of the council's recommendations on grounds that the problems of western mining had too long been disposed of with generalities and that the resolution carried specific recommendations for each affected mineral.

Mr. Williston pointed out that the governors in approving the proposals were not asking for recovery of that half of that domestic market which already had been lost to foreign producers.

The resolutions adopted call for establishment of a national mineral policy "without delay" which allocates to US.. producers half of the domestic market.

The governors hit hard at the surpluses in the Federal minerals stockpile, asserting that no excesses be disposed of until Congress and the Administration delineate the national mineral policy.

"Congress should specifically prohibit the making of loans and grants in aid to develop foreign production of any minerals and metals which are being imported into the U.S. in surplus amounts," the program declares.

Adequate import taxes on copper are proposed, but the peril point at which they would become operative was not spelled out.

Tariffs and quotas, or a combination of both, are proposed ofr lead and zinc above levels of current quotas and tariffs.

The governors proposed that sale of the U.S. Treasury's silver stocks be discontinued because in the "not too distant future the Treasury will have to buy silver for its own coinage requirements at probable higher prices."

An annual quota or tariff is proposed for mercury, fluorspar and cobalt imports in preservation of "at least one half the domestic market."

A quota program for tungsten under which the receipts from current tungsten tariff would be allocated back to domestic producers. No individual producer of this metal would receive more than one-fifth of the total import tax allocations, however.

The governors asked that no more contracts be signed for purchase of foreign-produced uranium and that all restrictions, except licensing, on sale of uranium materials to consumers other than the U.S. be removed.

A "close watch" on the dumping of potash into the U.S. was requested.

A program analagous to the wool plan was proposed for such metals as antimony, chrome and manganese.

Opposition to the wilderness bill was voiced. And the governors suggested that a study be instigated to see if the U.S. Department of Interior was really following a program of multiple use of the public domain.

There was no resolution on gold because of the devaluation implications. The council did point out, however, that with current outflow of gold continuing, the nation faced a serious fiscal situation which could lead to devaluation under more unfavorable conditions than now obtain.

H. K. Porter Builds Plant For Refractory Brick

A $12-MILLION PLANT for production of magnesia from sea water and manufacture of refractory brick was completed in late August by H. K. Porter Co. Inc.'s Refractories Division at Pascagoula, Miss. Daily production from the chemical plant section of the operation is about 125 tons of periclase.

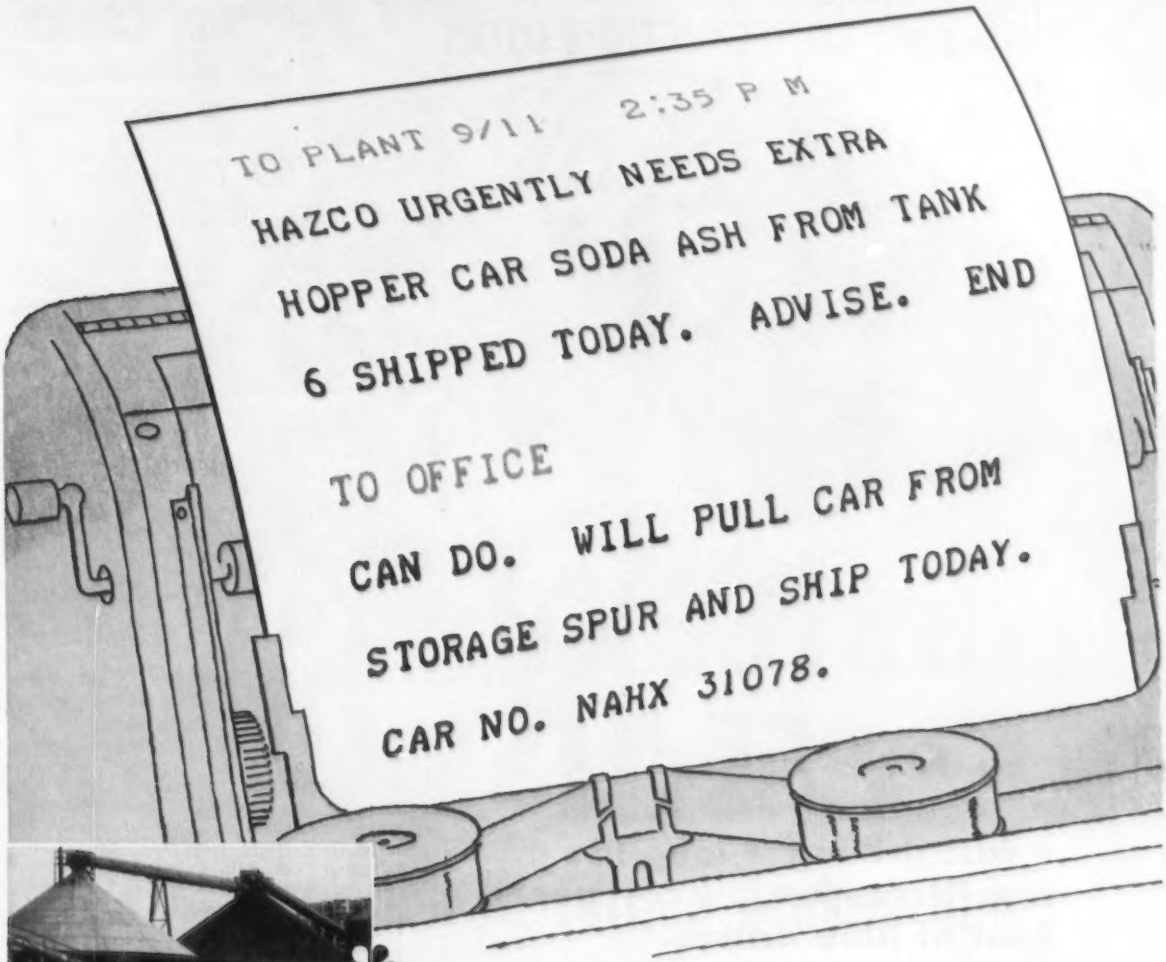
In the process, 13.2-million gpd of sea water is mixed with dolime (burned dolomite, 342tpd) and reacted to create insoluble magnesium hydroxide. The product is then thickened and washed and run through disk filters. The 50% solid filter cake is put through a caustic calcining kiln, briquetted and dead burned.

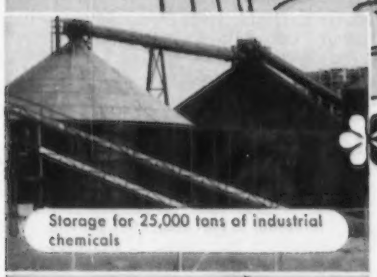
In the brick plant, chrome ore goes through a jaw crusher, rotary dryer, gyratories and rolls crushers, is screened (oversize goes to ball mills) and then batched with periclase from the chemical plant in an automated bin setup. Fresh water and binder materials are introduced before the brick presses take over. Several special combinations of material are used for various refractory roles.

Alberta Nuclear Test In Oil Sand Postponed

CALLING FOR an underground nuclear explosion which would release energy equal to a "moderately large earthquake," Project Oilsand underwent some tremors itself in October as a result of reports from Ottawa that the proposed project of Richfield Oil Corp. was being indefinitely postponed.

West End "fills the order"...


TO PLANT 9/11 2:35 P M
HAZCO URGENTLY NEEDS EXTRA
HOPPER CAR SODA ASH FROM TANK
6 SHIPPED TODAY. ADVISE. END
TO OFFICE
CAN DO. WILL PULL CAR FROM
STORAGE SPUR AND SHIP TODAY.
CAR NO. NAHX 31078.


Storage for 25,000 tons of industrial chemicals

Immediate shipment in leased hopper cars

Vast natural source of raw material

Meeting service requirements to the letter and producing superior soda ash of consistently accurate particle size and chemical analysis are the essentials to which the West End organization is uniquely geared. A system of rapid communications linking our sales office in Oakland with our production, technical and shipping departments at the desert plant site permits each department head to have a complete understanding of the customer's individual requirements and to make firm commitments or provide the desired information promptly.

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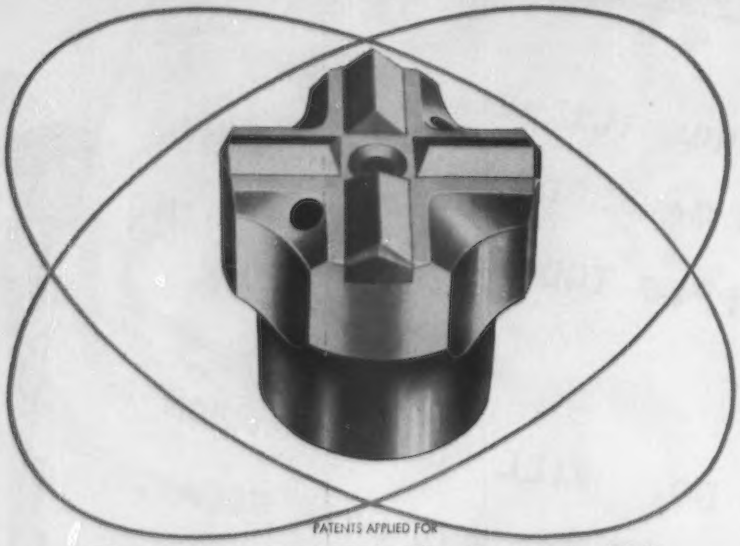
DRILLING BENEFITS THAT ATTRACT MINING AND CONSTRUCTION USERS



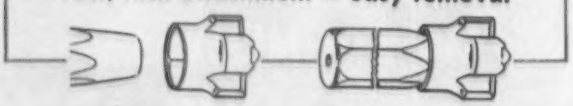
LIDDICOAT TEE CEE BIT

• needs no resharpening • fast drilling • long life • low first cost • low cost per foot of hole drilled.

The exclusive, shallow, long-life inserts of the TEE CEE BIT need no resharpening. LIDDICOAT design precludes the reverse taper dullness common to conventional bits and gives TEE CEE BITS a fast and effective drilling life lasting far beyond the point where conventional bits must be withdrawn from service for sharpening.

The bodies for LIDDICOAT Bits are forged from nickel alloy steel. The tremendous pressure which extrudes the desired shape retains the important grain of the steel . . . flow lines being compressed rather than cut across as is usual in forgings of this type. The compression of the material and retention of the unbroken flow lines give LIDDICOAT Bits unusually strong structure.

New taper socket — no threads fast, firm attachment — easy removal



WESTERN Rock Bit Manufacturing Company

552 West 7th South • Salt Lake City 1, Utah

Oil Sand *(Continued)*

These reports reaching Western Canada were based on remarks attributed to Mines Minister Comtois. The Minister later issued a clarifying statement to the effect that the experiment "may not be taking place in the near future."

It was pointed out that the report of the technical feasibility committee appointed by the federal government had not yet been received, and when it was received, it most likely would be referred to the Atomic Energy Control Board. The Minister, therefore, is believed to feel that "many months will elapse before the matter even comes up to the cabinet for final decision."

Freeze-up of 1960 in the northern Alberta oil sands region (which contains 300-billion to 600-billion barrels of oil by mathematical calculations) has been viewed as the earliest possible time the test could be staged, provided all necessary agreements were reached by all concerned faster than actually thought likely. The winter of 1961 now appears to be a likelier time than any other for the experiment.

American Gilsonite Looks At Open Cut Hydraulics

AMERICAN GILSONITE CO., Salt Lake City, has under consideration a revolutionary type of open cut mining by hydraulic jet piercing of the mineral found at Bonanza, Uintah County, Utah.

Experiments and studies to date indicate that such procedures could nearly triple production, eliminate timbering, improve safety conditions, and vastly reduce costs. Mining costs are of paramount interest to AGC which converts the gilsonite at plant near Grand Junction, Colo., to gasoline and metallurgical grade coke (E&MJ, September 1957). The gasoline is sold in competition with product produced from crude oils in the area. And the coke is sold in competition with cokes produced at oil refineries.

At present, AGC, a subsidiary of Standard Oil Company of California and Barber Oil Corp., uses a hydraulically impelled, crawler tractor device employing two nozzles with 2,600 psi stream pressure to cut gilsonite from conventional mining face, underground. Capability with one machine is nearly 1,000 tpd.

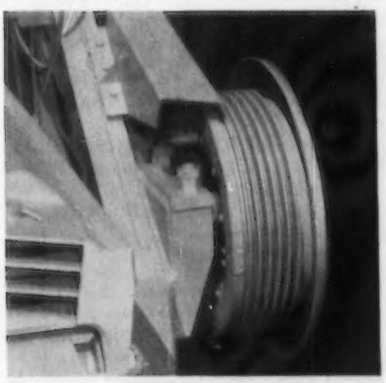
By suspending two nozzles vertically from the top of the 1,600 foot gilsonite vein, the company experimentally has produced up to 1,300 tons in one eight hour shift, however.

The machines would be suspended on a back-moving rig. Shattered gilsonite would fall with water to the bottom of the mine, then be conducted, as at present in underground mining, by "V" notch to central sump from which it is pumped to surface, sized and then moved in water slurry a distance of 72 miles to Grand Junction via 6-in. high pressure line.

Currently, the mine must be timbered, but no timbering would be required by the proposed open face mining method.

Should the mined out area cave for-

B.F.Goodrich Hi-Torque Brakes help Curtiss-Wright operators scoop up profits



Rear view of Curtiss-Wright Model CW-226 Scraper shows 26" x 7" B.F.Goodrich Hi-Torque Brake. Model CW-226 Tractor uses 22" x 7" size. Brakes for this unit are actuated with air-over-hydraulic master cylinders.

Why do so many big Curtiss-Wright tractors and scrapers (like the Model CW-226 shown above) rely on new B.F.Goodrich Hi-Torque Brakes?

For plenty of reasons: 1. Exclusive full circle stopping power enables the B.F.Goodrich Hi-Torque Brake to stop up to twice as fast as conventional two-shoe brakes. Operators boost job profits by hauling heaped payloads, running more cycles per hour. 2. B.F.Goodrich Hi-Torque Brakes stop smoothly, without fade, so operators can tackle terrain once considered unsafe.

Other factors important to the cost-conscious operator: 3. B.F.Goodrich Hi-Torque Brakes adjust themselves automatically. 4. They need no lubrication. 5. Lining changes can be made with simple hand tools and a minimum of time. 6. Brakes can be operated by either air-over-hydraulic or direct-hydraulic actuation.

Rugged, dependable B.F.Goodrich Hi-Torque Brakes do a better stopping job on almost any kind of wheeled off-road vehicle. For more information, ask your dealer or equipment manufacturer, or write *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept. EM-119, Troy, Ohio.*

B.F.Goodrich *Hi-Torque brakes*

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Why buy a valve that is a compromise? Specify Flex Valve—the original, the only valve with full opening, no obstructions. Nothing less will give you maximum operating results.

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Gilsonite *(Continued)*

ward, a new hole or shaft would merely be drilled and the cutting process continued.

AGC believes that it can successfully suspend the jet piercing equipment down more than 1,000 ft into the mine from surface without undue mechanical difficulty.

Utilization of underground television cameras to keep tabs on flow of water and "ore" along bottom drift to central sump also is under consideration. The jet-piercing team on top of the vein at surface could, by this device, keep close check on rate of ore flow, development of any obstruction, etc.

By use of its 72-mile transmission system, capacity of which has been expanded to a potential 1,000 tpd from an initial 700 tpd of gilsonite by careful experimentation on settling rates. AGC delivers the mineral to Grand Junction at cost less than $1.76 a ton. This cost includes filtration at coke-refiner at Gilsonite, Colo., near Grand Junction. AGC can now move a slurry 45% gilsonite as against 35% two years ago, and this without pump increase.

Installation of another booster pump between pump station at Bonanza and Baxter Pass at 8,500 ft elevation, would serve to hike throughput of gilsonite at 1,400 tpd. The line in the last year has carried an equivalent of 15,700 railroad cars of gilsonite through its 6-inch orifice.

A new 1,400 tpd flotation unit employing fatty acids as reagents has been installed at Gilsonite, Colo., to reduce silicon content of the coke product. The silicon comes from the rock walls of the Bonanza mine. This flotation unit would insure that regardless of the rock matter falling from surface in open face cutting, the end coke product would contain less than .04% silicon. The beneficiation unit at Colorado plant now serves to cut the ash content of virgin gilsonite from 0.20% to less than 0.15%.

Two Uranium Firms Sue U.S. on AEC Policies

A $5-MILLION SUIT has been lodged with the U.S. Court of Claims, Washington, D. C. by two Pacific Northwest uranium firms. They allege the Atomic Energy Commission broke its word on domestic uranium procurement to their damage.

The suit filed by Northwest Uranium Mines, Inc. and Silver Buckle Mining Co., both of Spokane, Wash. could be precedent-making in the domestic uranium business.

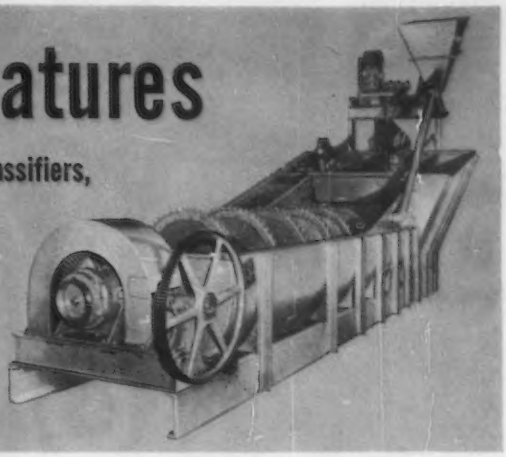
There are even those in mining who insist parallel actions could be instituted on similar grounds by producers of tungsten, mercury, cobalt, and other "strategic metals" whose mining was expanded at Government request, only later to suffer certain specific changes in rate or amount of procurement.

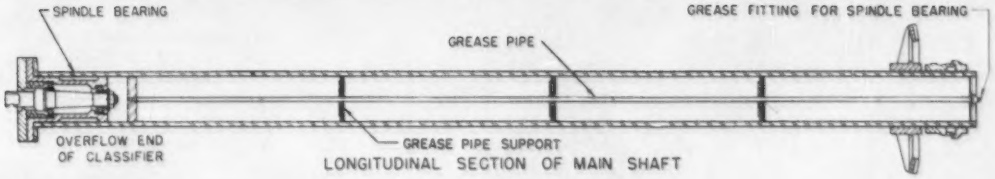
Northwest and Silver Buckle maintain that they suffered losses as a result of

Exclusive Akins Features

which assure low-cost, trouble-free operation of classifiers, heavy media separators and densifiers

50 years of experience in the design, manufacture, and operating performance of spiral classifiers, heavy media separators and densifiers, has proven the importance of the exclusive mechanical features of the Akins machines... importance in terms of metallurgy, and in the economy of long, trouble-free operating life with minimum maintenance.





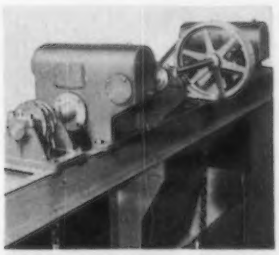
LONGITUDINAL SECTION OF MAIN SHAFT

SUBMERGED BEARING

The patented submerged bearing has proven its advantages of durability, trouble-free operation, and ease of maintenance.

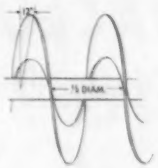
LUBRICATION

The submerged bearing is grease-gun lubricated through a pipe in the main shaft; thus the pipe is isolated from tank contents and protected against breakage. Grease fitting is at upper end of shaft for maximum convenience.



MECHANICAL LIFTING MECHANISM

The lifting device consists of chains, chain sprocket sheaves, and motor-driven or hand-operated reducer unit. Experience has proven this mechanical arrangement to be the most positive, with no possibility of slippage. Minimum maintenance. No packing glands or rods to become worn.



SPIRAL PITCH

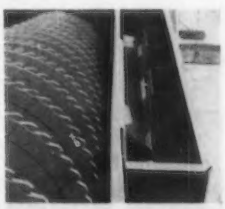
50 years of experience has shown that the half-diameter pitch gives maximum raking capacity and results in less slippage and less wear than advanced pitch spirals.

TANK SUPPORTS

Web beam substructure supports tank. There's no load to be carried by tank. This also reduces installation cost by eliminating need for extra sub-structures to support tank.

WEARING SHOES

Wearing shoes are made of various alloys, including Climax 42-A. Patented serrated wearing shoes are available for special applications. Special inner shoes are provided for heavy rake loads.



DRIVE

The bevel gear, V-belt drive has proven to be the most trouble-free and flexible. It permits mounting the motor, or motor-reducer, horizontally; and changing speeds quickly and inexpensively, by simply changing V-belt sheave ratio.

OVERFLOW BOX

An overflow box, with a pipe connection, is furnished as standard... requires only a single connection.

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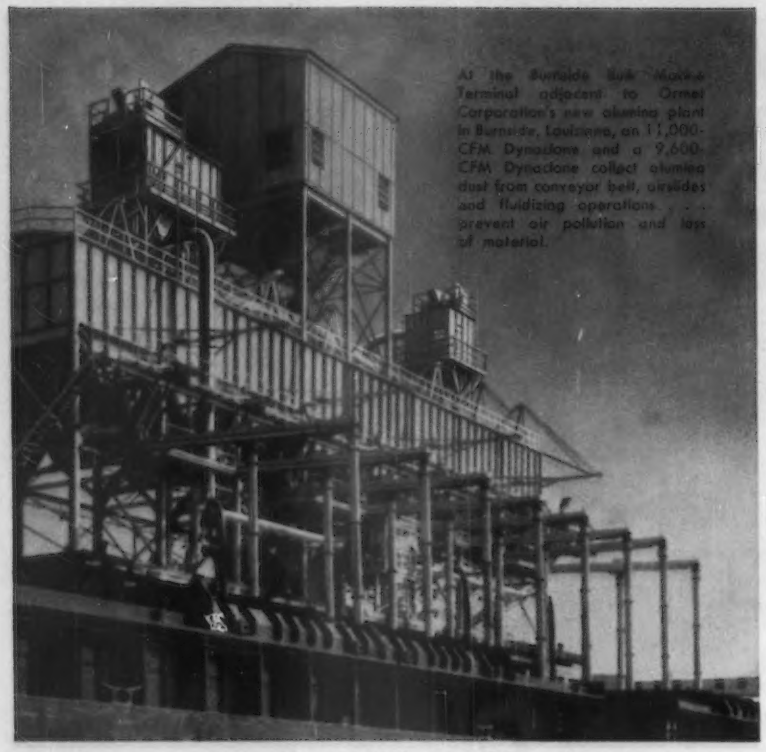
At the Burnside Bulk Marine Terminal adjacent to Ormet Corporation's new alumina plant in Burnside, Louisiana, an 11,000-CFM Dynaclone and a 9,600-CFM Dynaclone collect alumina dust from conveyor belt, airslides and fluidizing operations . . . prevent air pollution and loss of material.

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AEC Suit *(Continued)*

following the AEC into the domestic uranium procurement program launched in 1946 only to lose out when the AEC imposed basic changes in that plan two years ago.

The suit represents what is believed the first instance of a domestic uranium producer attempting to collect damages because of policy changes on U.S. uranium procurement as enunciated in the Oct. 28, 1957, policy statement of AEC.

IN THE U.S.

ALASKA

A geologist for the Nomura Mining Co., Ltd., of Tokyo is making a survey of cinnabar deposits at three areas in southwest Alaska with a view to future mining, according to Ray Wolfe, president of the Alaska Mines and Minerals Co.

The geologist, Kazu Adachi, is inspecting the Red Devil mercury mine near Sleetmute and two other properties along the Kuskokwim River, Wolfe said.

The Red Devil Mine is owned by DeCoursey Brewis of Toronto. The other two properties are owned by Alaska Mines and Minerals.

The Japanese are interested in producing unrefined mercury-antimony concentrate—"soot," Wolfe said. He said the "soot" could be barged to Bethel, 200 miles down the Kuskokwim River and there put aboard ocean-going ships for Japan. The Bethel port is open five months of the year.

JOT Mining Co. of Oklahoma City is planning to mine and ship several thousand tons of uranium ore from the Kendrick Bay Mining Co. pit at Bokan Mountain this fall and winter. Shipping will be to the Dawn Mining Co. plant at Ford, Wash. Bokan Mt. is on the southern part of Prince of Wales Island. Operations were scheduled to start during the last week of September.

John T. Brockway and Sid Ellis are planning to diamond drill the Cobol Group gold property, formerly held for many years by Mr. and Mrs. George Bolyan. The Cobol Group is on the west coast of Chichagof Island on Slocum Arm.

A drilling operation has been in progress on a large iron deposit some distance from tidewater in the Bradfield Canal country north of Ketchikan. The deposit was discovered a few years ago by local Ketchikan prospectors. Standard Slag Co. and C. T. Takahashi, Seattle importer-exporter, are reported associated in the venture.

USSR&M Co. has moved the Pedro Creek Dredge, No. 4, to Chicken Creek in the Fortymile. The boat was scheduled to start digging in the new location by Sept. 15. Dredge 2, sunk on Fairbanks Creek last spring by ice-

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Longer-Reaching TRACTOLOADER Stays Back From Truck and Still Dumps Load Right in Center

There's reach to spare with a TRACTOLOADER. Note that this TL-20 is not even up to the body of this 12-ton truck — 8 feet high, 8 feet wide — yet it's dumping right in the center. No time-consuming loading from both sides . . . no pitching . . . no wasting time dozing to distribute material evenly — and no banging-up truck and loader.

In addition to extra-long reach, both the big TL-20 and TL-16 loaders, and the medium-size TL-14 have *exclusive* ONE-LEVER speed and direction control. Operator works fast because he goes into and out of *any* forward or reverse gear at will, while moving, with one lever.

To make your TRACTOLOADERS even more productive, you get bigger-than-ever carry capacity. The TL-20 carries 9,000 lb and has a 130-hp diesel engine. On the TL-16, you get 7,000-lb carry capacity and a choice of a 109-hp gasoline or a 104-hp diesel engine. The new TL-14 has 5,300-lb carry capacity and gives you either an 83-hp diesel or an 86-hp gasoline engine.

To further increase the efficiency of your work, each of these loaders has a whole family of buckets. You choose the size that is most suitable for your operating conditions and the materials you handle. Buckets range from 2¼ to 5 yd for the TL-20; 1½ to 4 yd for the TL-16; 1 to 3 yd for the TL-14.

Let your Allis-Chalmers dealer help you decide which TRACTOLOADER would be best for you. Start getting that extra reach and extra production now. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

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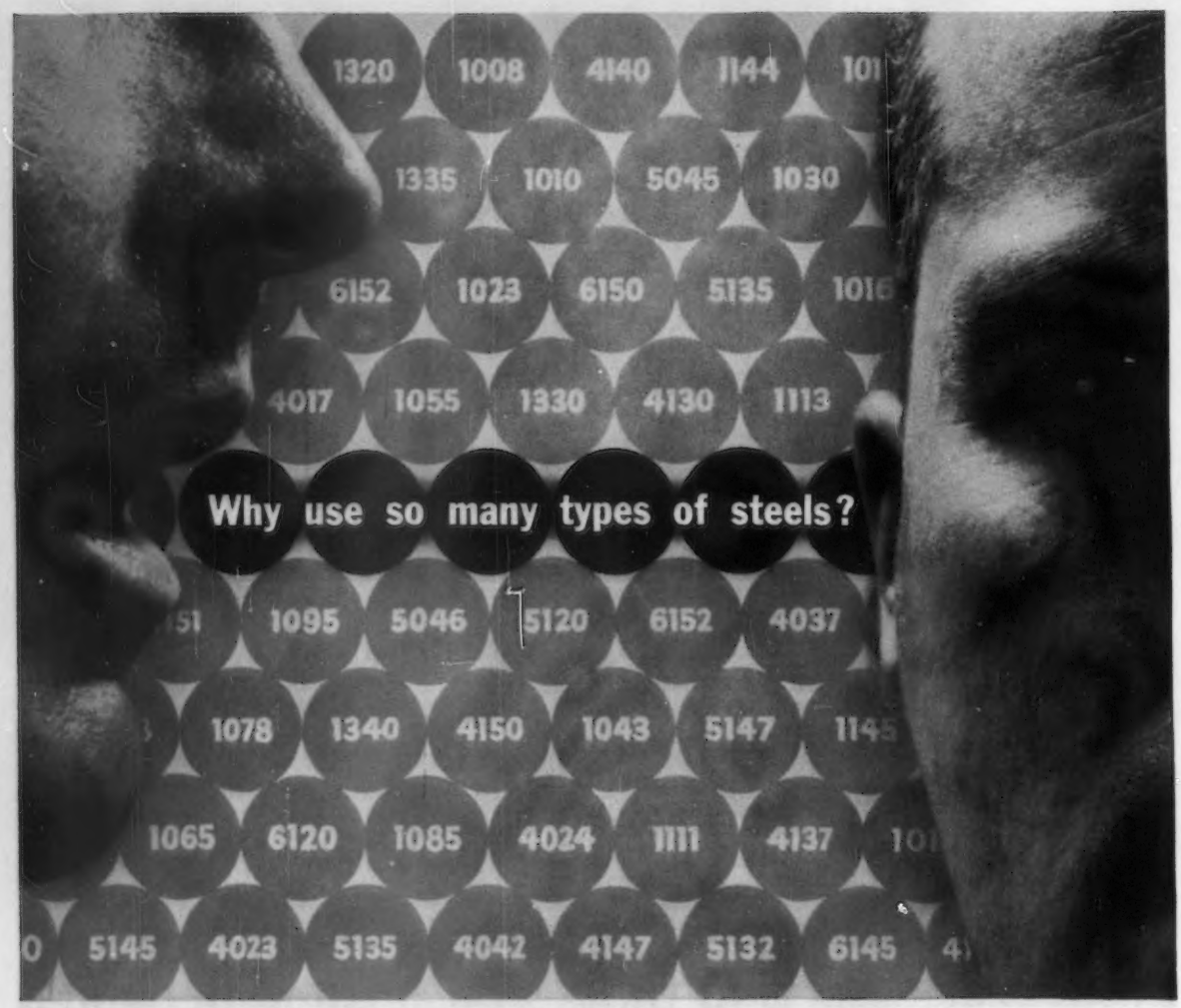

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These two General Purpose alloy steels can solve most of your steel selection problems. One a carburizing type . . . the other a through-hardening type — with just these two alloy steels you can satisfy practically all your engineering requirements.

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When you need through-hardening steel, simply specify 4340. It's ideal for parts of any section size. It provides exceptionally high strength and toughness. Responds reliably to heat treatment. It's weldable under proper conditions and machines at relatively high hardness.

And when you want to carburize, simply specify 4620 steel. It resists warpage and distortion in heat treatment. Responds reliably and uniformly, too. Provides a tough, strong core to support the hard wear-resistant case.

Best of all, both are carried by Steel Service Centers from coast to coast, ready for delivery right off the shelf. If you need heavier-duty or special purpose steels for very particular applications, suitable nickel alloy steels are also available from your Steel Service Center. To get a buyer's guide of centers that carry 4340, 4620, and other nickel-containing grades, simply write Inco.

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THE INTERNATIONAL NICKEL COMPANY, INC.
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INCO TRADE MARK

Alaska *(Continued)*

blasting, is now repaired and digging again. Dredge No. 8 on Engineer Creek was through on Oct. 30, apparently for keeps. Dredge No. 5 has mined out the company's ground on Dome Creek and has come to a permanent stop, according to news reports.

ARIZONA

Western-Knapp Engineering Co. of San Francisco, Calif., has been awarded a contract to design and engineer the 15,000 tpd copper flotation concentrator for American Smelting and Refining Co.'s Mission Project near Tucson (E&MJ, Sept., p 18). Cost of the total project has been estimated at over $40-million.

Estimates are that the annual throughput of the mill is to be 5.4-million tons, producing approximately 45,000 tons of copper per year. E. H. Scheick, project engineer for Asarco, will work with WKE.

The total project, including construction, is scheduled for completion in approximately two and one-half years.

CALIFORNIA

New Idria Mining and Chemical Co. proposes to reopen its Strawberry tungsten mine southeast of Yosemite National Park next spring, according to C. Hyde Lewis, president.

The reopening is projected in light of current improvements in world tungsten prices plus plans to develop an ammonium paratungstate product from the Strawberry scheelite.

Lewis said that New Idria had been working closely with Minerals Engineering Co. and subsidiary Salt Lake Tungsten Co. in the latter firms' ammonium paratungstate process. The view is that New Idria would be permitted to utilize this process on ores and concentrates produced west of the California-Nevada line, according to discussions among the firms.

Reopening of the Strawberry mine at this time is not possible because of elevation of properties. The integrated mine-mill operation is amenable to only 200 days processing because of the 7,000 foot altitudes.

COLORADO

Ernest Hoffman of Silverton, who is directing mining operations at the Rouville mine in Red Mountain area of the San Juan, reports satisfactory progress being made on the Rouville Tunnel. The original plan to drive a tunnel under known orebodies is being done. The tunnel, on completion, will drain a large area above in which mining operations have been previously seriously hampered because of numerous water courses.

With a five man crew now staying in

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Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".

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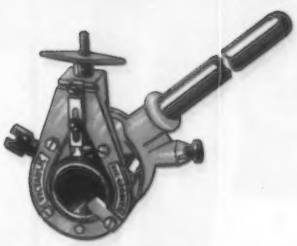
For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB



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Elbows, Tees, Reducers, Laterals, *a complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".

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Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

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VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.

Colorado *(Continued)*

camp above timberline, Creston mine near Westcliffe is now on a two shift basis. Recent additions to the mine crew includes Emil Hartbauer and two other former Cripple Creek miners. Limited stockpiling of uranium ore is under way at the mine.

Open again after 30 years of inactivity is the White Raven gold, silver, lead mine near Ward. It has been leased by Conrad Smith, Guy Dart and Hollis Allen, all of Boulder. The trio has constructed a mill near the mine site to eliminate shipping and treating costs. Approximately $3-million in ore has been mined from White Raven since the turn of the century.

American Metal Climax Inc. has purchased property from Walter Byron of Kokomo for $105,000. The property is in Kokomo and undoubtedly is to be used as disposal area for tailings from the Climax Molybdenum Company operations. Byron also gave American Metal Climax an option to purchase the Pacific placer for $100,000.

IDAHO

Floyd Wilson, Hailey, and Martin Curran, Hagerman, report a pending shipment of a railroad car load of "high grade" lead-silver ore from the LeGrand group of claims seven miles northwest of Hailey.

The two developed the ore while completing annual assessment work on the properties. No assays were given.

The men said the shipment would be sent to Salt Lake reduction centers as soon as strike in nonferrous metals industry permits.

J. C. Kieffer, manager of the Northwestern mining department of the American Smelting and Refining Co., reports that a raise coming up under the collar of the company's Galena mine No. 3 shaft has been holed through and that workers are enlarging this raise to shaft size by shrinkage methods and installing shaft sets as they go down. Drifting, he said, has also been resumed on the 4,000-level at the Galena with satisfactory results. A small station has been cut on the 4,000-level in the main shaft for the installation of an auxiliary hoist.

Bunker Hill Co. will begin construction immediately of its multi-million dollar fertilizer plant in Kellogg, home of company's mining and major metallurgical operations. Both Kellogg and Kennewick, Wash., had been considered as plant site.

Major reason for selecting Kellogg was that basic ingredient sulphuric acid is available there and could be used there without freight penalty. Sulphuric acid is by-product of company's electrolytic zinc plant. Kellogg was chosen after careful analysis of marketing, supply and technical factors.

Bumstead and Woolford, Spokane, and associated contractors, will build the first unit, a $2-million phosphoric acid plant with starting capacity of 130 tpd in Silver King Gulch just below the company's zinc plant. Sufficient building area has been set aside for additional facilities to produce fertilizers.

Dorr-Oliver, Inc., Stamford, Conn., has been engaged in developing details of design and layout for project since late 1958.

Hecla Mining Co. is carrying out an exploratory diamond drilling program in the American Silver extra-lateral rights area of the Coeur d' Alene district's silver belt from the 3,000-ft level of its Silver Summit mine into Rainbow Mining Co. ground.

Sunshine Mining Co. has announced plans to sink a new No. 6 shaft some 420 ft below the present bottom level of the company's silver mine near Wallace. This will open up a 4300-ft working level and will be the greatest depth yet reached in the famous mining section of North Idaho, 1720 ft below sea level and about 300 ft below the present deepest workings of the Bunker Hill mine at Kellogg and the Asarco Galena mine near Wallace.

The famous old Hercules mine of the Day mining interests of North Idaho is being closed down. Rollin Farmin, manager of Day Mines Inc., said equip-

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for your string!

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Sure winners in performance and production! Spang Bits and Stems, developed by skilled experts, are a safe bet to pace the field in long service and economy. Win, place or show you can be sure with Spang.

① SPANG CHURN DRILL BITS drill more holes per bit at lower cost! Fully heat-treated, high carbon, molloy steel, or 4340 steel. They have added strength in pin and blade sections to enable them to take the toughest drilling conditions in stride. Semi-dressed ends speed finish-dressing.

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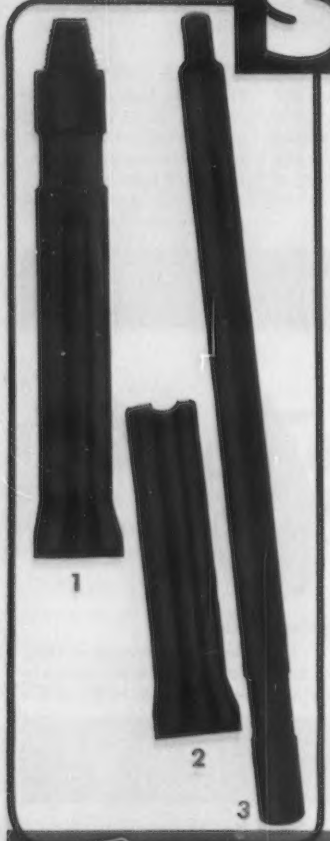
③ SPANG INTEGRAL ROPE SOCKET TYPE STEMS with heat treated swivel socket and swivel. Drill more . . . drill longer for less with these rugged, efficient stems. Made from one bar of steel with only a threaded box joint with integral rope socket top the stem's uniformity cuts vibration or whipping. Tools turn freely in the open swivel socket keeping the hole round and straight.



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MARION 181-M

The new levels of output and efficiency made possible on operations that can use large haulage units make the Marion 181-M a logical machine for expanded pit mining operations.

Here's a husky 9-yard machine with the traditional strength, power and endurance of Marion mining shovels - - plus small machine cycle time for an extra payoff every day.

With low-maintenance Ward-Leonard controls, power is applied smoothy and quickly, yet held within controlled limits that safeguard the machine against undue shocks or strains.

The chain propel simplifies crawler design and provides increased protection for the final propel mechanism, especially on shovels where the drive chain is enclosed and dips in oil.

A disc-type air clutch permits the operator to engage the travel mechanism without stopping the machinery, permitting faster move-ups.

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EXIDE-IRONCLAD BATTERIES

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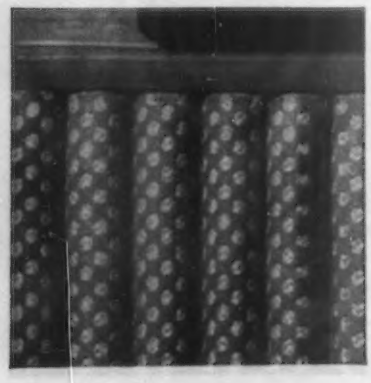
More ton-miles per dollar—that's the reason most cost-conscious mine operators prefer Exide-Ironclad Batteries for mine locomotives.

Experience has proved over the years that no other battery make matches Exide-Ironclad for average life in service and tonnage hauled. Rating for rating and dollar for dollar, Exide-Ironclad gives you more real value . . . more return on your investment.

Today's Exide-Ironclad features improved tubular construction, making it even better than the models that chalked up the industry's records. So you can expect even longer life potential and superior performance.

Total work output, not mere price, is the key to battery economy. When you buy batteries, specify Exide-Ironclad and get the most production capacity your dollar can buy. For details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.



50 years ago, Exide patented the now-famous Exide-Ironclad tubular positive plate battery. For power and economy, nothing has ever matched it. Yet Exide engineers have constantly improved it. Today's battery packs more power, gives longer life and greater economy than ever before.

Exide®

Idaho *(Continued)*

ment will be salvaged and the workings will be allowed to fill with water. The property, discovered in 1900, is located at Burke, north of Wallace, at one time produced 6% of the nation's lead and has paid more than $21,500,000 in dividends to its stockholders.

MICHIGAN

Following the dismantling of the No. 1 and No. 2 timber ore docks of the Chicago & North Western Ry. at Ashland, Wis., in past years, the No. 3 and last dock of the company is now being torn down. These docks have handled ore from the Gogebic range for about 75 years. Future ore from the Gogebic will be shipped from the Soo Line's Ashland docks. Some Gogebic ore may go to the docks at Escanaba as has been done before. The No. 3 dock is expected to yield about 13-million board ft of timber and 25,000 tons of scrap iron and steel.

MINNESOTA

The suit of the state of Minnesota against the Oliver Iron Mining Division was dismissed "on technical grounds." The state asks for the right to drill on private property when it believes the property—undrilled or only partially so—contains more ore than the owner estimates, for tax purposes. In the meantime, while further suit is pending, the state will ask U.S. Steel Corp. for permission to drill on the property near Eveleth where it brought in drills without permission and was restrained by an injunction.

The Lake concentrator plant of the Cleveland Cliffs Iron Co. near Taconite was sold to the W. S. Moore Co., Duluth. The plant had been used for treating an old stockpile of lean ore.

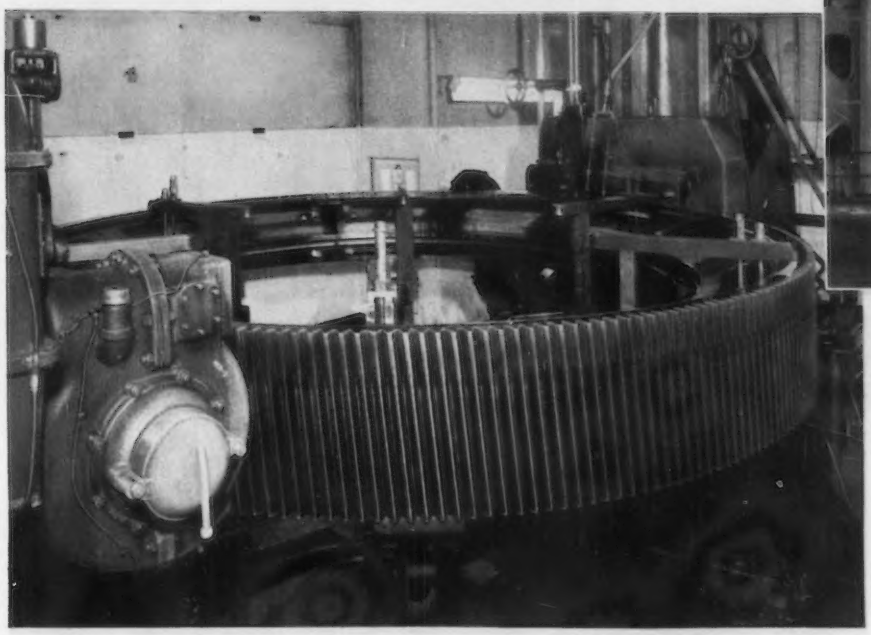
The highest grade ore shipped from the Lake Superior area in 1958 came from the Vermilion range — about 500,000 tons with a 61.67% iron content—and the Marquette range of Michigan with over 3½ million tons, 54.61% iron content. Both ranges are predominantly underground mine producers.

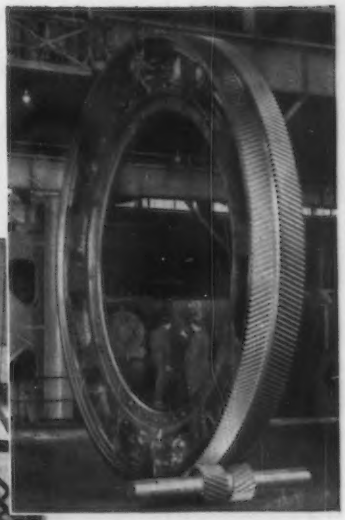
Due primarily to reduced shipments of iron ore, Minnesota receipts from taxes are down over $5½-million for the fiscal year ended June 30, 1959. During the same period the state debt increased about $38-million to $158-million.

The Minnesota Conservation Federation has awarded Erie Mining Co. the 1959 Business and Industrial Conservation Achievement award. Erie was particularly commended for its careful reuse of water; avoiding waste and pollution or depleting the source of supply, the Partridge river watershed; for its manner of disposing of the necessarily large amount of rock tailings and for the effectiveness of its operations.

Gears by FALK

. . . a good name in industry





ABOVE: In foreground, split ring herringbone gear, 16¾ feet in diameter. In background, a single helical gear is being rough-cut on special hobbing machine (which also can cut herringbone or spur gears).

LEFT: Split ring gear receiving final cutting on special hobbing machine, designed and built by Falk. It is operated in a temperature-controlled room to minimize dimensional variations.

Here's how MODERN GEARS can SAVE MONEY for you . . .

• Are you making the mistake of driving your costly mills and kilns with gears of antiquated design—or with gears made to a price, rather than to the topmost standards your operation deserves?

Falk Helical Gears are the most efficient gears (98½%) you can buy. They can bring you these substantial savings:

1. They last longer, hence reduce your over-all gear investment.
2. Pinion replacement can be sharply reduced when gears are properly proportioned and installed, and adequate lubrication and enclosures are provided.
3. They give better performance and longer life to your driving and driven machinery.
4. Their higher possible ratios permit use of higher-speed motors—a saving in motor costs and in power bills.

As the country's largest supplier of precision gearing, Falk is the manufacturer best equipped to *recommend without prejudice* the exact gear most suited to your specific application. Whatever type gear your job demands—single helical, herringbone or spur—Falk has unsurpassed facilities to engineer and produce it.

You are invited to contact any Falk representative—also, **write for Report 6170,** "Advantages of Helical Gearing"

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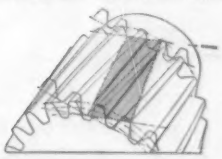
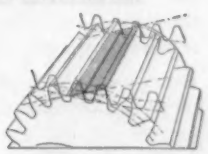
GEAR FACTS FOR ENGINEERS

The greater capacity of Falk Helical Gears, whose teeth are cut obliquely across face, is shown by the sketches below. When helical gears mesh, two or more teeth are always in contact; they share the load. Result: maximum contact area, greater capacity and strength.

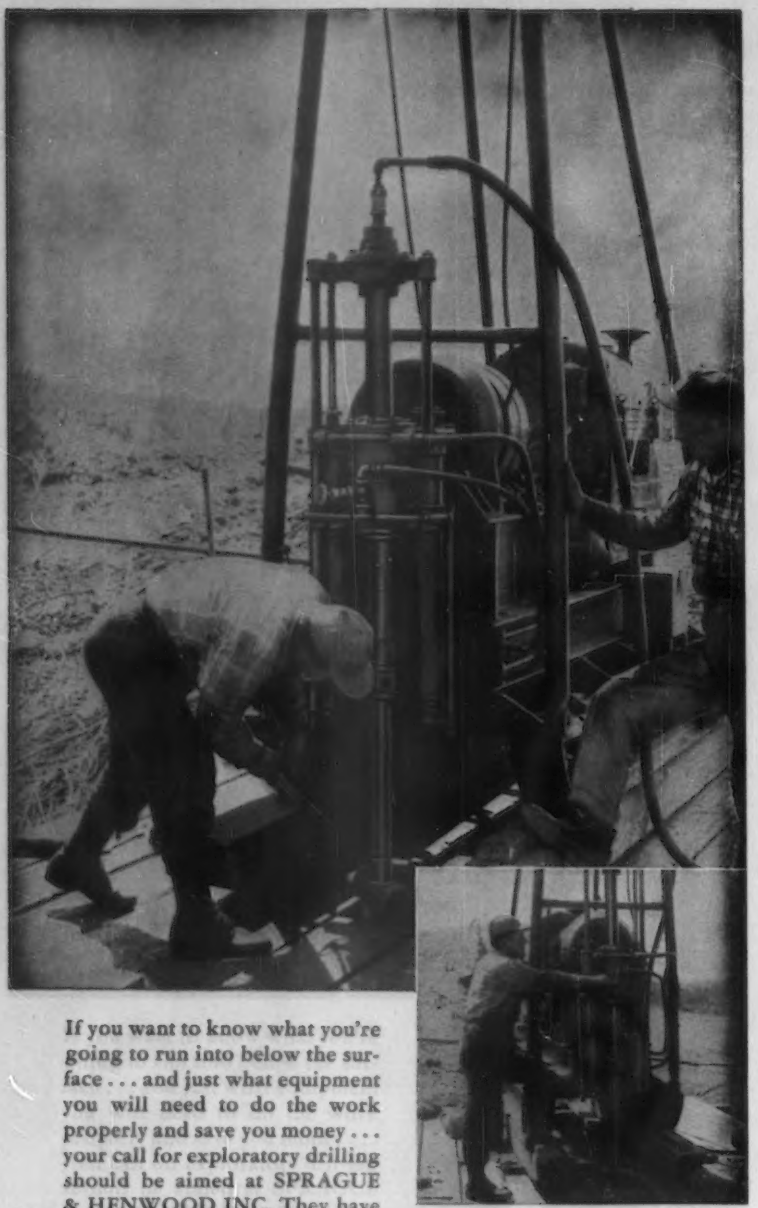


By contrast, on gears with teeth cut straight across the gear face (as in spur gears), there are alternately one or two teeth in contact when gears mesh. Result: Very small contact area. The load-carrying capacity (rating) is determined by minimum contact conditions when but one tooth sustains the load.



On the basis of comparative sizes of contact areas of the two gear types, the high capacity of helical gears over competing types is apparent. Engineers, operators and maintenance men who have experienced the advantages of Falk Helical Gears are unwilling to "settle for less".

YOU'LL KNOW WHAT'S THERE ...BEFORE YOU KNOW IT...



If you want to know what you're going to run into below the surface . . . and just what equipment you will need to do the work properly and save you money . . . your call for exploratory drilling should be aimed at SPRAGUE & HENWOOD INC. They have a wealth of experience and modern equipment ready to serve you. Well-trained personnel, adequate supervision and the latest in machinery, all tend to assure you the results you are looking for.

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Minnesota *(Continued)*

Shipments of iron ore on the Great Lakes for August were 797,979 tons—the lowest August total for 27 years—and, except for 1932, the lowest since 1900. Total shipments to Sept. 1 were 36,375,821 tons: excepting 1958, the lowest since 1946. Settlement of the steel strike will result in capacity shipments until cold and ice bring the season to a close.

Erie Mining Co.'s transportation of taconite pellets from its Hoyt Lakes plant to the Two Islands harbor for the first six months of 1959 was 1,947,000 tons compared to 928,000 tons in 1958. Reserve Mining Co. does not transport its pellets since they are produced at Silver Bay on Lake Superior. Reserve's production this year for the first six months was 2,847,393 tons: 577,883 tons more than in 1958.

MONTANA

President Eisenhower has signed a bill authorizing long-term mineral leases on the Crow Indian Reservation in Montana.

Present law permits the Indians to lease lands for 10 years with an option to renew for another 10 years. This was changed to "10 years and as long thereafter as minerals are produced in paying quantities."

The change was made to encourage prospecting for minerals, including oil and gas.

Articles of incorporation were filed by Montana's Secretary of State for a new Butte mining firm, Obelisk Exploration Co.

The company said that its purpose is to locate, work, develop, lease, buy, sell and deal in mines, mine locations, claims and mining dredges.

Incorporators signing the articles were Joseph W. LaComb and James P. Goodrich, both of Basin, Montana and Koehler S. Stout of Butte.

A brass plant which will employ 50 to 100 men and women in its initial operations, and more with anticipated expansion, will be established in Butte.

The announcement was made Oct. 2 by Tim J. Sullivan, chairman of the board of the Sullivan Valve and Engineering Co., and former mayor of Butte. He said that the new industry will be incorporated for $1-million under the name of the Butte Brass Co. and will manufacture gas controls, brass valves and fittings in conjunction with the control division of the Sullivan Co.

Sullivan traveled to Massachusetts and Pennsylvania to negotiate with three brass companies for the purchase of equipment to be set up in Butte. He said that one of the three firms would be purchased to transfer its operations to Butte.

Butte Brass Co. would be the first of its kind in the Northwest. Copper and zinc are prime metals for the manufacture of brass. Sullivan said, "For many years

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WITH LUKENS "T-1" STEEL
TRADEMARK

Where the going gets rough, versatile Lukens "T-1" steel fights back. For repair or modification of heavy duty equipment such as truck beds, chutes, bucket teeth and dozer blades, this special duty steel plate can be ordered from *warehouse stock* in a wide range of plate sizes and gages. Lukens "T-1" is the modern mining steel—you can work and weld it in the field as readily as in your shop. Its terrific resistance to abrasive impact—coupled with an extremely high yield strength—means fewer replacements and often greater payloads. That's why more and more equipment builders are using Lukens "T-1" to provide longer life in shovel buckets, trucks and other mining equipment. Remember to specify the extra-tough 321 min. BHN quality. For performance and application details, request our special booklet, "Lukens 'T-1' for Toughness." Address Manager, Application Engineering Dept., N119 Services Bldg., Lukens Steel Company, Coatesville, Pennsylvania.

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LUKENS ®

Montana *(Continued)*

we have been producing such raw material here only to ship it elsewhere. The institution of a brass plant here will give us opportunity, not only to produce such mineral wealth, but to follow through and manufacture a finished product from natural resources right in our own backyard."

He said that with copper becoming generally accepted as cheaper and much more durable for use in plumbing, the field for combination of copper plumbing installations along with brass fittings is unlimited. In the field of control valves, he said, it is equally unlimited.

Montana, Idaho, Oregon, Washington and other northwestern states, along with Canada, he said, will supply a good market for the equipment which the new plant can produce.

NEVADA

Big Divide Mining Corp. has struck highly mineralized vein material — 840 ft from the adit of the Big Divide mine six miles south of Tonopah. As a result all work is now being centered on drifting operations in that area. Work is continuing 16 hours per day, and company officials plan to prospect the area

(Continued on p 148)

IN REGINA for the mines ministers conference were, left to right: Hon. J. A. Maloney, Ont.; Dr. M. Boyer, federal deputy minister of mines, Ottowa; and Hon. W. K. Kiernan, British Columbia.

Canadian Mines Ministers Study Problems

A FREE-WHEELING DISCUSSION of Canada's new National Energy Board and criticism of the nation's fiscal policies from a prominent U.S. industrialist, were highlights of the 16th annual conference of provincial ministers of mines held in Regina, Sask. Sept. 14-16.

The conference set up continuing committees to study problems dealing with the use of diesel equipment underground health protection in uranium mines and to examine inconsistencies between the income and mining tax acts.

A plea came from Dr. G. B. Langford of the University of Toronto, and Dr. J. B. Mawdsley, University of Saskatchewan, addressed to the committee dealing with geology, geophysics, prospecting and government regulations. The committee was chaired by British Columbia's deputy minister of mines, P. J. Mulcahy.

Dr. Langford expressed doubts that

NEW 30" PORTABLE SILICON RECTIFIER

IN DISCUSSION, left to right: G. H. Finland, manager of the Alberta and Northwest Chamber of Mines; C. S. Clements, director of mines, New Brunswick, and V. S. McRae, resident manager of Brunswick Mining and Smelting Corp. Ltd. Bathurst, Nova Scotia.

the nation's technology would be able to meet demands for minerals unless means of stimulating research are quickly found.

"Geology is the weak link in our chain of science," said Dr. Langford. "Our ability to find new ore deposits is not keeping pace. There is need for more research in the mineral industry to meet deficiencies in technology."

He urged the release of data now reposing in "the cemeteries which are exploration company files" to researchers to aid in the advance.

Dr. Mawdsley concurred and asserted that co-ordination between government and geological services would eliminate waste and speed development.

The National Energy Board came under fire from spokesmen for the uranium mining industry.

R. H. Winters, president of Rio Tinto Mining Co., and a former federal resources minister, said there should be no such board. It has sapped some of the vitality that goes with competitive development, he said.

Forecasting severe problems for his industry when uranium contracts with the U.S. government expire in 1962 and 1963, Winters said he would favor the board if it would be of assis.ance then.

"Our job is to ensure markets for uranium after that time. I don't think we can look to the National Energy Board for a great deal of help."

The Canadian mining industry is being harmed by tight money, high interest rates and the premium on the Canadian dollar, the conference was told on its opening day.

Cyrus Eaton, chairman of the board of Steep Rock Iron Mines, said his opinion was based on more than half a century of active participation in mining, banking and industry.

Accepting weak U.S. dollars for its $2-billion worth of mineral exports across the border is "costing Canada plenty," he said. Canadian miners, he said, pay operating expenses with premium Canadian dollars, sell for U.S. dollars and absorb the difference. This would cost the industry $100-million this year he said.

He also warned the nation not to close the door on U.S. capital.

Among those attending the convention this year were mines ministers from Saskatchewan, Ontario, Nova Scotia, Manitoba and British Columbia and New Brunswick.

Saskatchewan's mineral resources minister, J. H. Brockelbank, was chairman.

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"LO-BOY"

D-c power at 30% lower cost

General Electric's "Lo-Boy" portable silicon rectifier provides you with a new, more economical source of d-c power for mines, even thin seam mines. Here's why:

- **Low Initial Cost.** "Low-Boy" is priced about 30% less than mercury-arc rectifiers;
- **Requires Less Maintenance.** Except for cooling fans, there are no moving parts to wear out;
- **Easy Installation.** Sealed-dry transformer is one-half the weight of liquid-filled transformers. Rectifier car is 30% lighter than mercury-arc. Either car can be lifted by either end for easy handling.

Thirty-inch height makes "Lo-Boy" especially valuable for your present and future low-seam operations. New low height and two-car design provide approximately double the kw capacity in the same space required by other conversion means.

The equipment operates unattended. All live parts are enclosed. It's available in ratings from 300 to 500 kw, 275 and 300 volts d-c.

For more information, contact your G-E Apparatus Sales Engineer, or write to Section 532-1, General Electric Company, Schenectady 5, New York.

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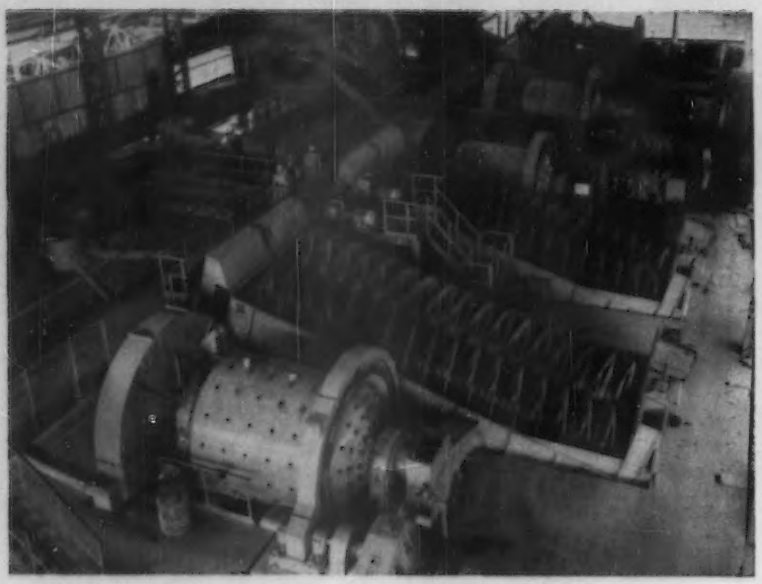


Shown here are four Hardinge 9-3-6-8 Tricone Mills grinding sulfide copper ores and mixed ores in a concentrating plant in the Belgian Congo, Africa.

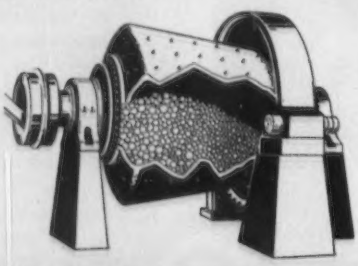
CORRECT BALL SEGREGATION
in the
HardingeTRICONE MILLS

Shop view of a 10½' Tricone with 9' long tapered shell.

Highest grinding efficiency and lowest ball and lining wear are common to mills with a correctly segregated ball charge. The Hardinge Tricone Mill is the only mill providing these essentials to low cost operation without the use of special linings or internal devices, which are subject to wear and are effective through only a part of their wearing life.

The Tricone also occupies less floor space for its grinding volume than any other ball mill built.

Every ball in the Hardinge Tricone Mill "minds its own business!"



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Nevada *(Continued)*

fully before driving ahead in the main tunnel. Jim Smith, of Tonopah, is superintendent of the operations.

George Behmer and Charles Overfield, both of Tonopah, have taken a lease on the Crown Point Globe gold mines in the Johnnie mining district of southern Nye County. Mrs. Augusta Overfield, Tonopah, is the owner. Machinery has been moved onto the site, and the property is being worked as a placer operation, since ample water is available.

Round Mountain Gold Dredging Co. has uncovered additional deposits both north and east of the area now being worked, according to an announcement by company officials. Electricians are putting in a power line to the new pit, and the discovery is expected to extend operations at the Nye County site for a considerable period. Values from the gravel now being mined are running $1.25 per ton, and the mill is treating 10,000 tpd.

Gordon Bettles, of Tonopah, has been producing fluorspar running as high as 60% grade from three claims in the Quinn Mountain Range of Nye County. Bettles acquired a lease-option on the property from owners Solan, Starls and Don Terrel, also of Tonopah, after the Wah Chang Corp. abandoned operations at the site when its Tempiute tungsten mine closed. The vein averages three feet in width and a 400-ft tunnel has been completed. Estimated tonnage blocked out is between 15- and 20,000 tons.

While Eagle Picher's new $2½-million plant east of Lovelock is operating on alternate weeks pending establishment of markets, the firm's plant at Clark's Station, 20 miles east of Sparks, is operating 16 hours per day and producing large tonnages of upgraded diatomaceous earth marketed over a wide area for use in insecticides, herbicides, insulation, abrasives and filters. Both mills are served by the Southern Pacific railroad which has spur lines to the mill sites. The Clark Station plant treats material from its mine a few miles south of the mill. The new plant treats material from a mine 30 miles to the west.

Goldfield Engineering Associates, of Las Vegas, leasers of the Prospector's Friend mine near Goldfield, are crosscutting from a point 300 ft from the portal to enable operation by stoping. A good producer in boom days, the property has a 1,000-ft tunnel dug by former operators. Exploration has revealed good values in gold and silver still available in the mine.

American Smelting & Refining Co. has announced it will make every effort to reopen and operate the Copper Canyon Mining Co. properties in Lander County which it recently purchased from the Small Business Administration. The Copper Canyon mines, a leading producer during the 1940's was granted a loan by the SBA and following default on repayments, SBA ordered an auction to be held Aug. 10 at which the Federal

Indiana quarry and a new approach to gondola loading

6-yd Michigan Tractor Shovel hauls own load . . . alone replaces standard 5 machine operation

By replacing a ¾ yd swing shovel, two 15 ton dump trucks, a hopper, and a conveyor with *one* Michigan Model 375A Tractor Shovel—this southern Indiana quarry has substantially slashed equipment investment for loading gondola cars.

Not long ago, the firm's president and his superintendent were talking over ways to increase loading efficiency and free some present equipment for work elsewhere. The firm was producing everything from aglime to No. 63 crushed stone. Stockpiles were spread out, loading cycles often 1,000 to 2,000 ft. Switching stockpiles with the swing shovel took valuable time. So did handling material *three* times (by shovel, truck, and conveyor) before loading into the gondolas.

Was there a better way? The company had long been impressed with the operation of their two 2¼ yd Michigan Model 175A Tractor Shovels used for loading trucks. Maybe a bigger Michigan, say with a 6 yd bucket, could replace the shovel-truck-conveyor system they were using? They called their Michigan Distributor.

323 tons/hr over 1800′ cycle

Deeds Equipment Company, Michigan Distributor in Lawrence, Indiana, brought out the big Model 375A, 335 hp Tractor Shovel. This Michigan, its 6 yd bucket and 30,000 lb lift capacity, easily scooped 11-ton loads of ¾″ stone. Travel was made over 1,800 ft cycles . . . and the material dumped directly into the railroad gondola cars. Time and again the Michigan made the trip and at the end of an 8½ hour day, had travelled 85 miles. Output totalled 2,750 tons of crushed stone, loaded into 35 gondolas of the 60 to 75-ton class. And, the Michigan *could* load, *with equal ease*, from any one of the many stockpiles.

Production like this sold company officials on the Model 375A and this new method of gondola loading. Output since purchase of the Michigan has averaged 2,500 to 3,000 tons a day. The swing shovel has been released for stand-by duties and the two trucks put to work hauling to the crusher.

"The Michigan is loading out stone faster than a continuous-flow conveyor, from the crusher," says the supt. "It now loads better than 50% of all rail stone shipments."

Time for "bonus" jobs

"Our respect for the Michigan has grown too," the supt adds. "When the 3 yd rock shovel broke down, it did a competent job of loading in the quarry pit. We've used it for emergencies ever since. And, the Model 375A's 25 mph speed produces free time for grading and compacting haul roads, a job formerly handled by a grader and occasionally a roller."

The firm's supt says, "After seeing the job the Michigan is doing for us now, and its proven dependability and speed, I believe we're headed for 60 car-a-day production with the Michigan. This would be just twice what we were doing the old way."

No obligation demonstration

Why not see what a Michigan will do *on your job?* There are eight models to choose from—16 cubic feet to 6 cubic yards, 3,000 to 30,000 lb lift capacities. Pick the model you want to see and call us. We'll be glad to give you a "no obligation" demonstration.

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The following are a few test results indicating comparative resistance factors.

Solution	60-Pound Kraft	Wet Strength Resin	Neoprene Treated (3%)
H_2O	0	72 hr.	86 hr.
10% HCL	0	6 min.	4 hr.
10% NaOH	0	6 hr.	72 hr.

Write us about your requirements and we will be glad to send samples for your testing.

. . And for your filter cloth requirements we weave fabrics of treated Cotton, VINCEL†, SARAN, DYNEL, GLASS, DACRON††, TEFLON°°°, POLYETHYLENE, NYLON, ORLON°, AND POLYMAX†. Samples sent on request.

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Montreal: Lee Benner Chem., 4700 Prince of Wales

Nevada *(Continued)*

agency bought the entire holdings. Resale to ASARCO was completed early in September. Officials of the latter firm assured Sen. Alan Bible of Nevada that an exploration program at Copper Canyon will be started as soon as possible, and a going mining operation will follow if found feasible.

Ernest L. Rink, of Yerington, who operates his one-man mine 22 miles south of that town, found an opal weighing 55 lb and measuring 18 in. at its widest point during September. The gem stone was found at a depth of 28 ft after Rink had dug the hole without resorting to blasting. The opal was uncovered in place by use of a hammer and chisel. The owner believes there are other similar stones in the same area.

Belmont, former seat of Nye County and for many years a ghost town, is experiencing a housing shortage as a result of activities of the Reliance Minerals Corp. which is operating the Van Ness mercury mine six miles northwest of the town. A 100-ft shaft has been sunk, and ore is treated in a 30-ton Cottrell rotary furnace at the mine site. Keith Meador, Fallon, is engineer, and Louis Cirac, Tonopah, is general superintendent of the operation. Officials of the company are operating under a lease and option agreement with John Connelly and Mrs. H. C. Lagenaur, owners of the mine and equipment. Reliance Minerals Corp. is a Nevada firm financed by California interests.

NEW MEXICO

Rare Metals Corp. of America now places its reserves in the San Mateo Dome area of McKinley County at more than 1-million tons of ore.

The ore grade (0.20% U_3O_8) is higher than originally anticipated, shareholders were informed in interim statement.

The company has scheduled output at rate of 400 tpd by end of this year. A program to recover uranium values in waters of the ore-bearing Westwater formation is scheduled.

Currently Rare Metals is shipping ore to the Kermac Nuclear mill, pending allocations of ore by the Atomic Energy Commission.

Principal income source was the Tuba City, Ariz. uranium mill and the Weiser, Ida. mercury mine and reduction plant.

The statement disclosed that Rare Metals has leased a potential lead-zinc property near Colville, Stephens County, Wash., where a preliminary examination indicates "it may contain substantial values" of these metals.

Full value can be established only by exploration and development. The properties were leased with a view toward ultimate improvement in the status of domestic lead zinc mining, E&MJ was told by an official of the firm's Salt Lake operating headquarters.

Questions

We've been asked about the Yieldable Arch

"How do you determine the spacing between Yieldable Arch sets?"

In general, Yieldable Arch sets are spaced 3 to 4 feet apart, though we know of installations where spacing ranges up to 6 feet. The important thing, always, is to space the sets closely enough so that the Arches and not the lagging will do the yielding. As a rule, the softer and heavier the ground, the closer the spacing.

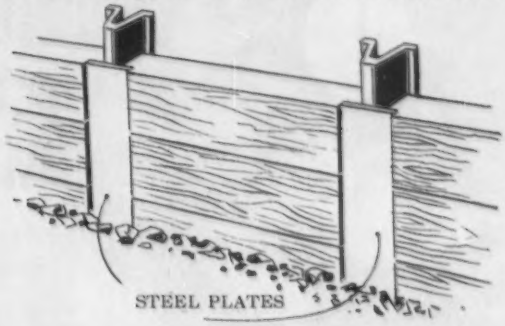
For lateral stability, each Yieldable Arch set should be tied to its neighboring set with channel struts and J-bolt clamps furnished by Bethlehem especially for this purpose. This strutting is usually installed at five points along the periphery of the Arch.

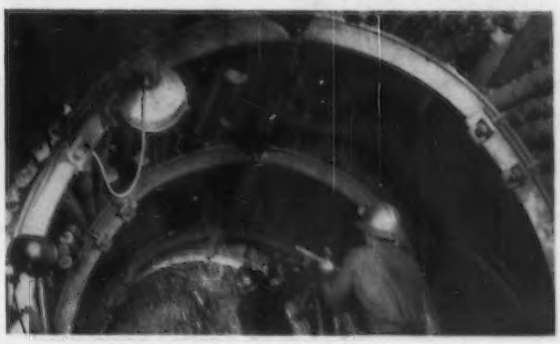
SEND US YOUR QUESTIONS

You probably have other questions of a specific nature, concerning the application of the Yieldable Arch or Ring to your mine. If so, by all means send them in; we will study your problem and reply as promptly as possible. Write Room 1041, at the address below.

"What method can you suggest to prevent scrapers from catching on the legs of Arches?"

A Michigan mine solved this problem by welding plates —about ½ in. x 5 in. x 24 in.—to the exposed edge of the legs, and then placing 4 in. x 6 in. timbers behind the plates. The timbers were notched so that the steel plates fitted snugly inside them. Note sketch below.





"Is the Yieldable Arch easily adaptable to such techniques as spiling and forepoling?"

Yes. And many mines right now are using their Arch sets in conjunction with these mining techniques.

In some upper Michigan mines, pipe spiling is used to protect the men at the face. Above the top blast holes, and angled slightly upwards, 4 to 8 holes 1½ in. in diameter are drilled 10 ft deep. One-inch pipes are inserted over the tops of the arch sets at the face, and the round is blasted. Pipes give support during mucking out, until next steel set can be placed (see photo above).

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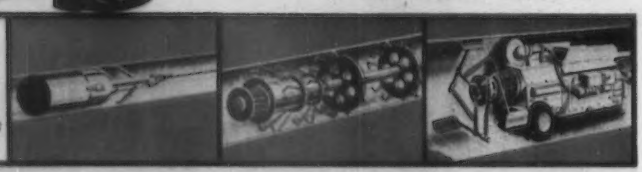
3 *processes*



THE TATE PROCESS is for pipe diameters from 4" to 16" and is done, "in place," after by-pass lines are set up to carry on with water service.

First, the pipe is scraped and cleaned. Then, cement mortar is fed in and applied under pressure to a compact thickness of 3/16" to 1/4" giving the final effect of one continuous, cement mortar lined tube.

THE SPUNLINE PROCESS is partly TATE and partly centrifugal, developed to provide a thin lining for preventing corrosion and to restore hydraulic flow, particularly in cast iron pipe. The cement mortar lining can go past fittings and openings. It can be applied "in place." Uninterrupted continuity is obtained.

CENTRILINE Centrifugal Process. Cement mortar lining ingredients are mixed to rigid requirements and applied under a high velocity spray with uniform speed. Rotating steel trowels spread the mortar to a smooth, hard finish. Pipe sizes vary from 16" on up to 144". Clay, cement, brick, steel, cast iron and wrought iron pipes may be CENTRILINED.

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New Mexico *(Continued)*

Extension of the mill contract for the Tuba City installation awaits completion of ore survey of firms shipping to that mill, principally the Orphan Mine of Western Gold & Uranium Co., located on south rim of the Grand Canyon in Arizona.

Richard D. Bokum II, president of Sabre-Pinon Corp., announced that the first production of uranium ore from Lance Corp. properties has been shipped to the Homestake-Sapin Partners mill at Grants.

Lance, a wholly-owned subsidiary of Sabre-Pinon, operates the properties acquired in December 1958, from Black Jack Corp. Bokum said the initial shipment of 250 tons of 0.22% U_3O_8 ore was from the Section 12 mine, McKinley County.

It is estimated that the mine can produce at a maximum rate of 1,000 tpd by December of this year. Approximately 600,000 tons of ore have been blocked out in the mine. Homestake Mining Co. owns a 25% interest in this mine and an adjoining section.

Bokum said that the Section 18 mine, wholly-owned by Lance Corp., has reached 135 ft of the proposed 350-ft depth. The Section 18 mine has 80,000-plus tons of approximately 0.40% U_3O_8, totalling 640,000 lb U_3O_8.

NORTH CAROLINA

Texas Gulf Sulphur Co. is conducting studies to determine if a lithium plant would be feasible in the Lincolnton area.

Company engineers, based at Lincolnton, are testing lithium bearing spodumene ore reserves, and also are trying out a pilot refining process patented by Basic Atomics, Inc. Texas Gulf has an option on the Basic Atomic method.

Dr. Charles F. Fogarty of New York, vice president of Texas Gulf, said the firm is most interested in the possibility of mining and processing lithium bearing ore found near Lincolnton, but that "it's going to take us some time to evaluate the possibilities" of locating a plant in the area.

The company has five-year options on over 1,000 acres of potential mining properties owned by Basic Atomics, most of the land being between Lincolnton, and Bessemer City, with other tracts near Dallas, Beaverdam and Gastonia.

Piedmont Minerals, Co., Inc., of Greensboro, a new firm and an affiliate of the North State Prophyllite Co., Inc., of Greensboro, has begun extensive prophyllite mining operations near Hillsboro.

It has purchased 85 acres of heretofore unused property on Occoneechee Mountain, considered to be one of the largest concentrations of low-grade prophyllite in North Carolina, and has constructed a plant for mining and processing of the ore.

Tennessee Copper Co. at Copper Hill, Tenn., has a geophysical crew investi-

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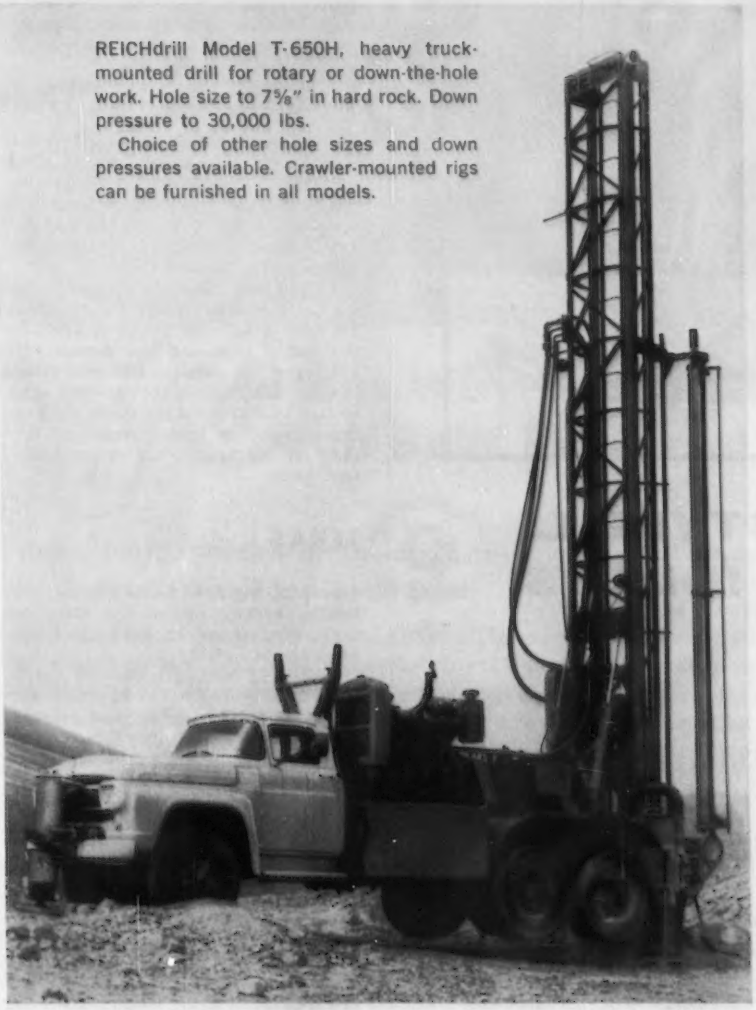

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1. **Infinitely variable speed** of drill rotation from zero rpm to maximum rated speed of model—permits the right rotational speed for every formation.

2. **Safety torque release** which practically eliminates all chance of drill breakage . . . protects all drive components.

3. **Direct-drive to drill stem** eliminating power loss . . . no complicated transmission to wear or maintain . . . no rotary table.

4. **In and out of the hole faster** because no kelly bar is required.

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- Full line—2¾″ to 5″ dia. idlers; commercial or precision roller bearings.

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North Carolina *(Continued)*

gating the Wilkins Creek pyrrhotite prospect in Haywood County, N.C. The principal method used so far has been an electromagnetic survey.

The Wilkins Creek prospect was first discovered in 1860 when a series of small shafts were sunk on almost vertical lenses of pyrrhotite that contained small amounts of silver, cobalt and nickel.

TENNESSEE

Du Pont Co. has opened a new titanium dioxide plant at New Johnsonville. The plant, located on a 1500-acre site, will produce about 125 tons of titanium dioxide a day for use in defense industries. It will employ more than 400 people with an annual payroll of $2,500,000.

Rep. Howard Baker (R. Tenn.) reports that the House passed his bill to equalize tax exemptions for small and medium sized mines (see E&MJ September p 172). He predicted full Congressional approval would come early next year after Senate action on the measure.

Baker's bill amends a section of the tax law permitting mines to deduct up to $100,000 a year for any four years for the cost of exploring new deposits. His bill leaves the original $400,000 ceiling in effect, but removes the four-year limit, so that smaller firms can enjoy the same benefits over a longer period of time than the big firms could accumulate in four years.

TEXAS

The "S. S. Richard," world's largest self-loading bauxite carrier, has completed her 100th voyage to Reynolds Metals Co.'s alumina plant.

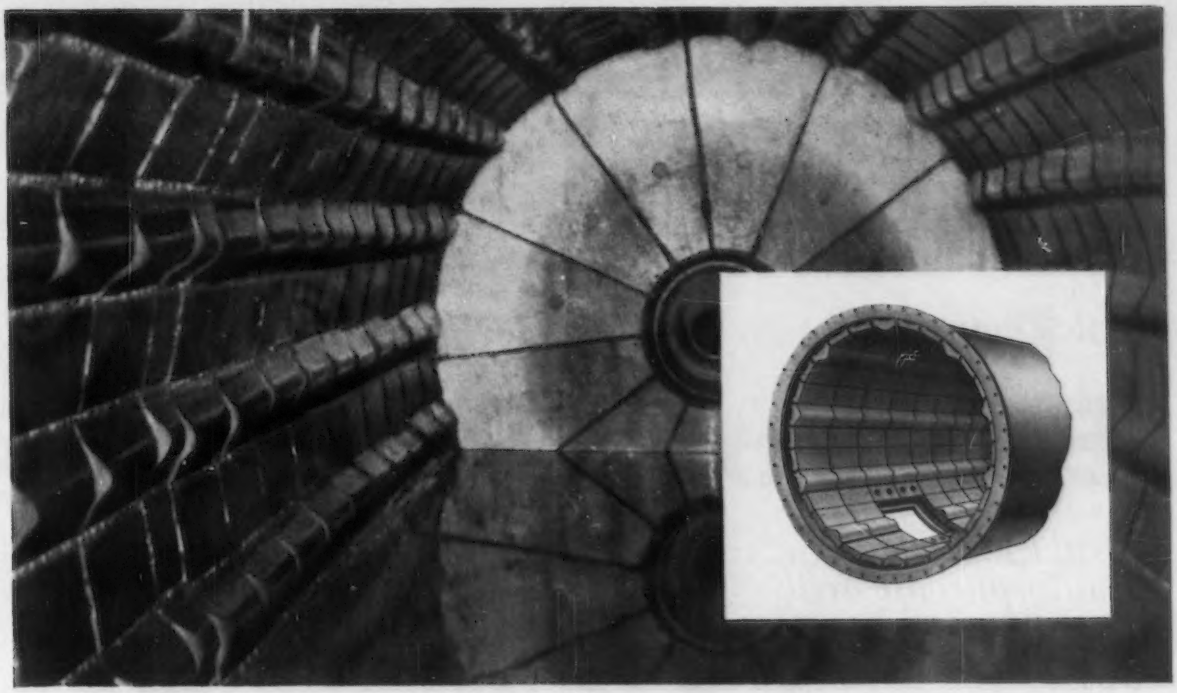
Walter L. Rice, president of Caribbean Steamship Co., a Reynolds subsidiary, stated that the Richard delivered in excess of 3,100,000 long tons of bauxite from Reynolds mines in Jamaica in its first 100 voyages.

The Richard is one of three self-unloading ships built for transportation of Renyolds bauxite from Haiti and Jamaica in the West Indies. It has a capacity of 32,400 tons. Its sister ships, the "S. S. Carl Schmedeman" and the "S. S. Louise," have a deadweight capacity of 13,780 tons and 17,060 tons, respectively.

UTAH

Stauffer Chemical Co. proposes an eventual 70,000 kw plant 15 miles north of Vernal in production of elemental phosphorus.

The new numbers result from an apparent decision of the firm to bid for a block of power from Flaming Gorge dam, necessary to start of a first unit of the plant. Power bid date is imminent, but not set. It would be rated at 35,000 kw. Originally, Stauffer announced it planned construction of an initial 20,000



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B&W Tube Mill Liners reduce capital, time and labor costs. Consequently, they reduce the cost of the material ground. Here are eight reasons why:

1. Lower Initial Costs—standardization eliminates chiller and pattern costs.
2. Longer Life For Liners—better quality control on a mass production casting, utilizing permanent molds, results in uniform wear. Ideal size for uniform chill and heat-treatment.
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4. Reduced Costs in Both Direct Labor and Outage—installation time is less because small size and weight of castings allows them to be handled easily, without cranes and with less fatigue for workers.
5. Reduces Costs in Storage Space—because small castings stack easily, little storage space is required. One design of casting interchangeable for all size mills also simplifies records.
6. Reduced Costs in Liner Inventory—standardization is possible because one design fits all diameters of mills. Standardization means quicker unloading and storage.
7. Reduced Costs on Breakage Claims and Delays for Replacements—small castings are rugged and almost impossible to break by handling. Large castings of hard, brittle irons sometimes break in shipment.
8. Reduced Costs in Determining Most Efficient Wear Patterns—you can get wear profiles consisting of all lifter ribs or all flats from the same castings, as well as a combination of both including straight or spiralled lifter pattern.

Liners are supplied in two nominal thicknesses, 1½″ and 3″ with 1½″ high lifters. Castings are 6″ wide x 12″ long. Positive seating of small castings on mill shell means less breakage of castings under operating conditions. For additional information on B&W Universal Tube Mill Liner Plates write The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

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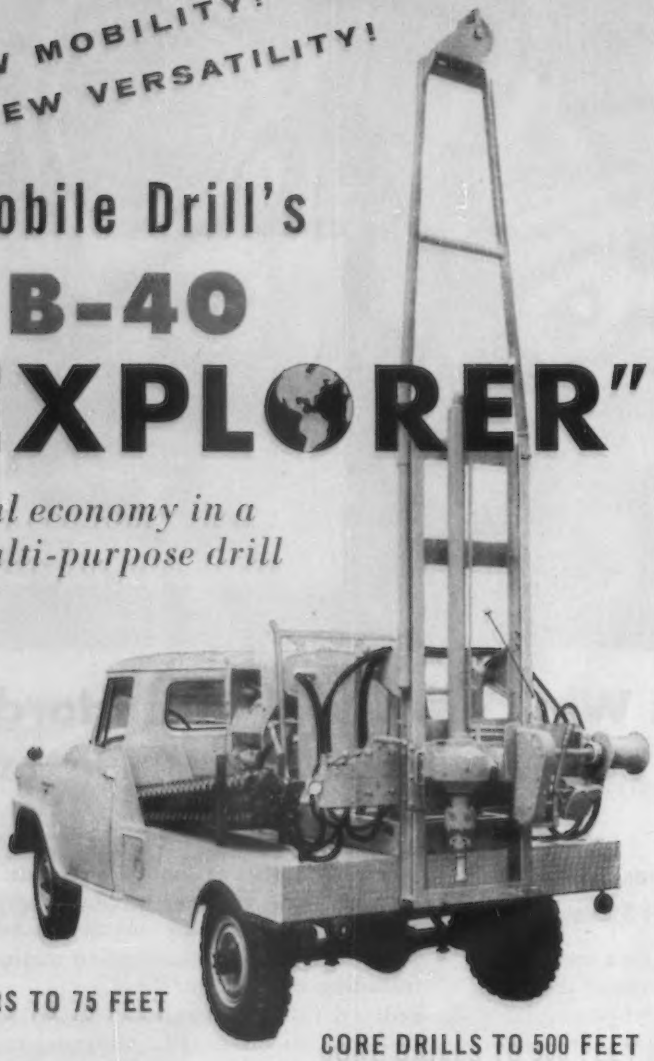

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Utah *(Continued)*

kw plant. That would fit into the low point average delivery of energy from Flaming Gorge, which will have a fluctuation of between 20,000 and 100,000 kw in energy, depending on stream conditions.

Stauffer would need added power from private sources to carry out its project. The firm did announce that affiliated San Francisco Chemical Co. had exercised option to buy over the years the 700-million ton, low grade (20% P205) deposit north of Vernal. San Francisco has completed successful beneficiation testing of the ore which could be mined by open pit method.

The acquisition Oct. 27 of Victor Chemical Works by Stauffer is said to be speeding up the Vernal project on part of the latter firm.

WASHINGTON

American Eagle Mining Co. reported that it has driven 65 ft of a proposed 125-ft shaft at the company's lead-silver-copper-gold property about 14 miles south of Kettle Falls.

Ronald E. Madden, Spokane, president of the firm, said that surface work has exposed 450 ft of a wide quartz vein that contains high grade ore stringers. Some ore has been stockpiled at the site. The firm plans a working level at the 125 ft depth. Work has been conducted at the site by a four-man crew during the summer and early fall. The work has been suspended for the winter months.

Washington State Conservation Department has awarded a contract to Hunting Geophysical Services of New York to conduct a $40,000 aerial mineral survey (AM and scintillometer) of northern Ferry and Okanogan Counties.

Field work is scheduled for completion about Oct. 15 but reports will not be completed until next February, according to Earl Coe, state conservation director.

Mining operations have been suspended at Midnite mine on the Spokane Indian reservation, it was announced by officials of Dawn Mining Co., a subsidiary of Newmont Mining Corp., which operates the mine.

The mining and ore hauling operations were closed down for the winter and will be resumed next spring. However, Dawn's uranium mill at Ford will continue normal operations.

Isbell Construction Co., Reno, Nev., and Vic-Ore, Inc., a Spokane subsidiary of Consolidated Freightways, have completed three-year contracts for mining and hauling ore, according to J. J. Crowhurst, Dawn manager. He said a year's supply of ore is stockpiled at the mill, which has a 400-ton daily capacity.

Officials said that about 130,000 tons of uranium ore were mined and hauled to the mill since May 1, when operations were resumed after the winter shutdown.

Your new plant or expansion idea

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Market available?

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Linden 4-4892

Cableway-DragScraper Blends, Reclaims Stockpiled Ore

Over a million tons of iron ore may be stockpiled in the new facilities of a South American mining company. The DragScraper permits better blending of the ore and reclaims all stockpiled material that does not flow by gravity into two 3000-ftph. tunnel conveyors.

The 10-yd. Dragscraper is suspended from a carriage traveling on a track cable between two self-supporting towers. These travel on tracks paralleling the storage area. Despite the size of the Sauerman installation, it may be controlled by one man.

(Condensed from a forthcoming Sauerman News)

Efficient Slag Removal

A 4-yd. Sauerman DragScraper machine is incorporated in the waste slag disposal system of a large copper smelting operation. The slag is flumed into two dewatering tanks separated by a common wall. After a tank is drained, the slag is reclaimed by the DragScraper to a hopper at the head end. The DragScraper is remotely operated from a station above the hoist to provide good visual coverage of the installation.

The monorail-trolley assembly at the tail end provides lateral movement of the DragScraper. The monorail spans the tanks, and a Durolite single block on the trolley carries the backhaul cable. Shifting is handled by a motorized winch remotely controlled by the hoist operator.

The DragScraper reclaims to the hopper at about 250 tph. The hopper, in turn, feeds a conveyor belt which carries slag to the disposal area.

(Condensed from Sauerman News No. 155)

Handling Phosphate Ore

Ore concentrate is stockpiled and reclaimed as required to the foot of a bucket elevator by a Sauerman DragScraper Machine at a Southern chemical plant.

A self-propelled tail tower travels around the perimeter of the stockpile. The tower is shifted to change the line of operation. DragScraper haul length is 400 ft. The operator's station for the Sauerman hoist is located above the conveyors to give a clear view of the pile.

(Condensed from Sauerman News No. 151)

MORE NEWS AND INFORMATION

Issues of Sauerman News giving greater detail about the installations on this page are available on request. For more information on your materials handling requirements, contact Sauerman Bros., Inc., 626 S. 28th Ave., Bellwood, Ill. Linden 4-4892.

Washington *(Continued)*

Negotiations for new mining and hauling contracts will depend upon the outcome of Dawn's negotiations with the Atomic Energy Commission for concentrate purchases covering the 1962-66 period, according to Crowhurst.

Mining has been banned on 260 acres of land along the south fork of the Clearwater river between Washington Water Power dam and Fall creek, the Department of Interior announced.

The withdrawals are subject to valid existing rights from all forms of appropriation under the public land laws—including mining, but not mineral leasing laws. The land is reserved for use of the forest service as recreation areas, streamside and roadside camps.

Fifteen parcels of land are involved, ranging in size from one to 40 acres.

Miners, prospectors and others in the area who spoke in their behalf told a bureau of land management hearing examiner in Grangeville March 19 that such withdrawals would hinder development of placer mining along the river at the mouths of streams involved.

Forest officials contended that additional sites need to be developed on the Nezperce national forest for recreation. They told the examiner that the sites selected for picnic and campground in the proposed withdrawal would be ruined if mining were permitted. Erosion would be detrimental to recreation grounds, spokesmen for the service said.

Sluice box placer mining was done in the area. Miners contended that such work could be done without excessive erosion and that topsoil could be replaced.

WYOMING

Utah Construction and Mining Co., San Francisco, proposes merger with Lucky Mc Uranium Corp., according to W. H. H. Cranmer, a vice president and director of Lucky Mc.

A stockholders meeting on Thursday, Oct. 1, at Reno, Nev.'s Riverside Hotel, failed to provoke any discussion of the much rumored merger talks on part of Lucky Mc principals, however.

U-C controls 60% of Lucky Mc, one of the largest miners and millers of uranium ore in Wyoming's open pit Gas Hills uranium district.

But 80% approval of any merger is required if a tax-free exchange of stock between the two firms can be accomplished.

Mr. Cranmer said that his discussion with U-C officials led him to believe that at least 90% of Lucky Mc stock would have to be voted in favor of a merger if the deal is to go through.

The official is president of New Park Mining Co. and associated Cranmer mining firms in Salt Lake City which have a substantial shareholding in Lucky Mc. Other principal shareholders, outside of U-C and the public, include Neil E. McNiece, discoverer of the Gas Hills district and Lowell A. Morfeld, both of Riverton.

a million yds. a month...

moved by Euclid "Twins"

At a mining operation in central Wyoming, a fleet of 18 Euclid scrapers is removing overburden from uranium ore at a rate of a million cu. yds. a month... nearly 21 million cu. yds. will be moved to uncover the ore body. It's a big, tough job to move that quantity of heavy sand over a mile of adverse grades up to 12%.

Maco Construction Co. of Rawlins, Wyoming, contractor on this stripping project, bought 12 Twin-Power "Euc" Scrapers of 24 yd. struck capacity to maintain high speed production. With two engines and all-wheel drive, these scrapers have the power and traction needed to move big loads up steep grades from pit to dumping area. Twin-Power is paying off in the big performance of Maco's five TC-12 Euclid crawler tractors, too—they're used for push loading this all-Euclid fleet of scrapers.

Wherever big tonnages must be moved on mine, quarry, industrial and heavy construction work, Euclid equipment provides more work-ability and better return on investment. The dealer in your area will be glad to supply facts and figures on Euclid rear-dump and bottom-dump haulers, scrapers, crawler tractors and front-end loaders.

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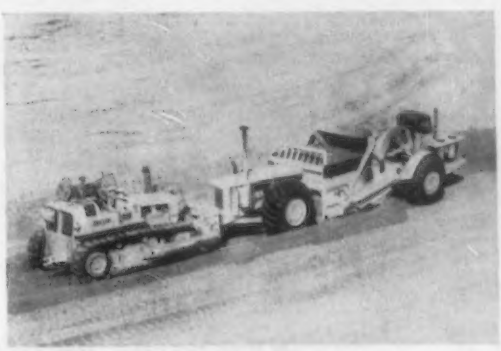

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Thermocoal Conveyor Belting

The test? U. S. Bureau of Mines Flame Test, designation U. S. B. M. 28-11.

The material? Thermoid-Quaker *Thermocoal* Conveyor Belting with fire-resistant, flame-retardant neoprene cover and cotton-nylon reinforcement.

The requirements? No more than one minute of burning after the belt is ignited.

The results? The flame went out *immediately* on *Thermocoal* belting. Afterglow disappeared in *one-third* the permitted time.

Underground safety is just one of the features of *Thermocoal* conveyor belting U. S. B. M. 28-11. It is light in weight and extremely flexible, yet tough enough to take shock, impact, and the abrasive wear of heavy, jagged loads.

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Wyoming *(Continued)*

Eighty-five employes—most of them hired in late September—will have the Gas Hills uranium plant of the Globe Mining Co. and the Union Carbide Co. in full operation around Jan. 1, according to Kendrick W. Lentz, superintendent of the new processing plant now under construction.

Construction of the 492-tpd mill, which is located 75 miles west of Casper on the Natrona-Fremont County lines, was started in late July by the J. H. Pomeroy Co., of San Francisco, Calif.

Lentz told a Casper Chamber of Commerce forum that a comprehensive training program for new employes who will man the plant was scheduled to begin Oct. 5.

Late in October, all the employes were to be moved to one of the company's plants in Colorado for experience in the work which they will perform in the new Gas Hills plant.

Various phases of the preparation for full production will be completed beginning early in November with full production planned on or about Jan. 1, Lentz said.

Of the 85 employes at the plant when it moves into full production, all but about 15 will have come either from Casper or Riverton or surrounding areas, Lentz stated.

A unique system has been planned for operation of the plant, under which short work-weeks will enable the employes to maintain homes and families in Casper.

Men engaged in actual 24-hour-a-day operation of the plant will work 12-hour shifts, with two crews able to complete 42-hour weeks in three and one-half days. The remainder of each week the men can spend with their families in town, Lentz said.

Day-shift employes will work four 10-hour days, enabling them, too, to spend nearly half of each week in town. While they are at the plant, the superintendent said, employes will live in motel-type bunkhouses, taking their meals at a company cafeteria.

Lentz explained that the working-living schedule was worked out because Union Carbide and Globe feel employes would not be satisfied to remain indefinitely in a remote mining town. Neither was it possible to work out transportation arrangements for the workers to travel the 75 miles each day to the plant during occasional severe weather.

Witt Construction Co., of Provo, Utah, started mill foundation work in mid-May of this year. Steel erectors was the Dresser-Ideco Co., of Columbus, Ohio.

The estimated $3-million mill consists of an ore crushing structure, a fine ores storage building, and an adjoining maintenance and a process building.

Wyoming Gas Co., Basin, has been authorized by the Wyoming PSC to construct a new 3-in. gas pipeline to the Magnet Cove Barium Corp.'s bentonite plant about three miles from Greybull.

The expanded gas facilities will provide additional service to the bentonite plant.

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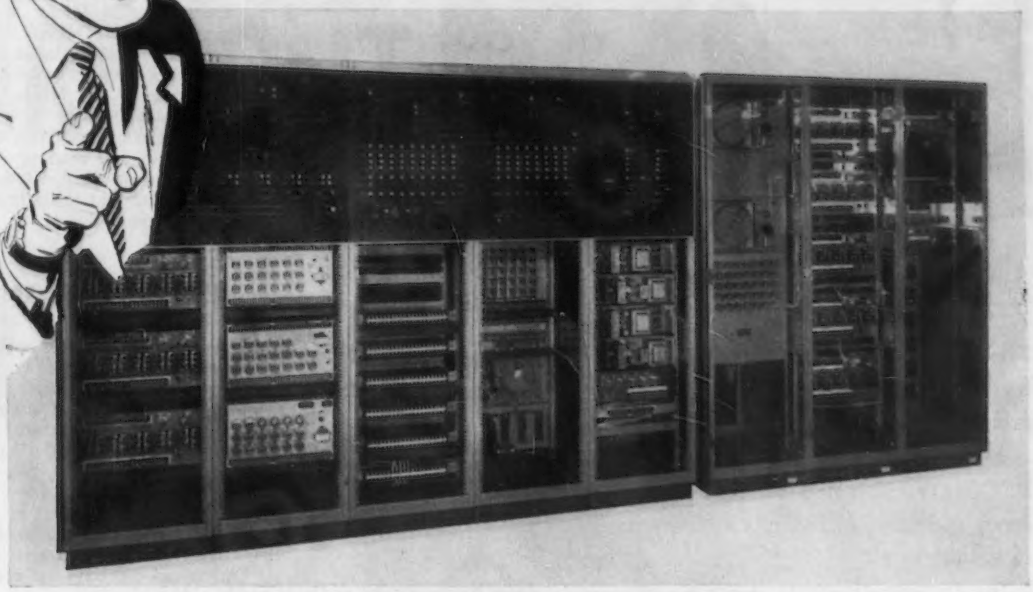

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IN CANADA

NEW BRUNSWICK

Over a dozen companies are currently active in the Bathurst-Newcastle area. It is estimated that approximately $1.5-million will be spent in the area this year. Diamond drilling has been, or is being done by Anaconda Co. (Canada) Ltd., Anthonian Mining Corp., New Jersey Zinc, Noranda Mines, McIntyre Porcupine, and N. L. Doucet. Prospecting is in progress by Noranda, McIntyre, Madsen Red Lake, Texas Gulf Sulphur, Silurian Syndicate, Area Mines, Doucet, and Bellechasse Mining. In addition, Consolidated Mining & Smelting Co., is sinking a shaft and erecting a headframe at its Wadge property, 32 miles southwest of Bathurst and is drilling on its California Lake holdings.

NEWFOUNDLAND

Development work is under way on a brand new orebody at Maritimes Mining Corp.'s Tilt Cove copper mine. The orebody was discovered in the long drive out to the East mine area on the 600-ft level. Drifting opened a length of 400 ft grading 4-5% copper over widths of 5.0 ft. A drill hole, put down 120 ft below the level, intersected 54 ft averaging 3.3% copper. It is believed that the discovery on the 600-ft level represents the top of an orebody that widens out as it goes deeper.

Atlantic Coast Copper Corp. has announced decision to push ahead with an underground development program to open up ore, aiming for production by mid-1960 from its copper property in the Notre Dame Bay area of northern Newfoundland.

The decision ends a lengthy period of quiet exploration and drilling at the former copper producer at Little Bay.

The plan is to open five levels to a depth of 1,000 ft and on the basis of findings to make a decision on the size of a milling plant after the new year.

The Atlantic Coast Copper property is 25 miles south of Martimes Mining, Ltd.'s new mine at Tilt Cove. Development is being directed by O'Brien Gold Mines, Ltd. which has a 43% interest in the 2.25-million share company.

The project is the second major step in a series of developments in the general Notre Dame Bay area. Maritimes Mining is at a 2,000-ton daily rate, and states it has a property at Gull Pond, south of Atlantic Coast Copper that it considers developing to production. At Baie Verte, Advocate Asbestos, Ltd. is pushing work at its major asbestos deposit.

As a former copper producer in the 1880's, the Atlantic property contains 216,000 tons of 1.48% copper in surface dumps which will help get the mill started. Ore indicated by diamond drilling is estimated by consulting engineers at 2,394,000 tons averaging 2.17% Cu.

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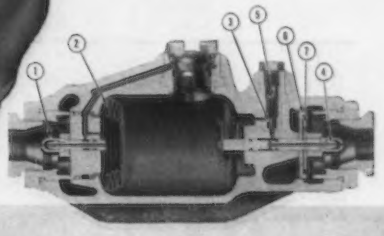

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AT-906

ONTARIO

Progress at Caland Ore Co. Ltd. (Inland Steel Co.) Steep Rock lease is on schedule and the first open pit ore will be shipped in 1960 with underground ore following in 1961. The shaft for the latter is down to about 1350 ft and development work is in progress. The shaft is one mile from the first pit location. To date nearly three quarters of the 180-million cu yds of lake bottom silt to be dredged has been removed.

Shaft sinking is getting under way at the gold property of Abino Gold Mines in the Red Lake area. Shaft is to go to depth of 525 ft with levels at 200, 350, and 500 ft. Initially a minimum of 1,800 ft of lateral work is to be undertaken. In addition extensive diamond drilling will be carried out. Construction of an all-weather road to the property and of a hydro transmission line is in progress. The new program follows completion of surface diamond drilling which gave encouraging results. Owing to the complex structure no attempt has been made to correlate results in terms of tonnage. Underground work is expected to provide a more accurate measure.

Paymaster Consolidated Mines is currently engaged in depth development program at its Porcupine area gold producing property. Crosscutting on the new deep levels at 4,225 and 4,375 ft is now under way to open up the No. 36 orebody. Crosscutting and diamond drilling are also being carried out from the 3,300-ft horizon to locate upward extensions of the No. 36 or associated orebodies.

McKenzie Red Lake Gold Mines is opening a new block of ore in the original, or main shear zone on the 1,050, 1,250, and 1,450-ft horizons at its gold producing property in the Red Lake area. It is hoped that at least 60,000 tons of good ore will be developed in this zone. A new stope on the 1,050-ft horizon has yielded 2,400 tons averaging 0.342 oz., the best the mine has seen in some time. On the 1,250 some 300 tons averaging 0.369 oz. has been taken from a new stope. On the 1,450-ft level, 285 ft of drifting in ore averaged 0.402 oz. ($12.29) gold per ton across three ft.

Sharp rise in ore grade at depth at the gold producing property of Upper Canada Mines, east of Kirkland Lake, has led to decision to deepen the shaft and consider boost in mill rate to 1,000 tpd. The No. 1, or main shaft, is to be extended to 4,900-ft depth from the 4,525-ft, or present bottom level. The latter has proven to be the richest level in the mine. Values running into ounces have been encountered, while better than average values are being obtained in the levels above. Average recovery in 1958 was $8.40 per ton, as against $8.83 per ton in the first five months of this year. Current mill capacity is 550-600 tpd.

Bicroft Uranium Mines, senior uranium producer in the Bancroft area, has arranged a further contract with Eldorado Mining and Refining Ltd. The new contract calls for sale of concentrates containing a maximum of 260,000 lbs of uranium oxide at price of $8 per lb. Deliveries will start after completion of the earlier contract for 3,300,000 lbs, and will be accepted up to Mar. 31, 1962.

Initial deep diamond drilling at the copper property of North Coldstream Mines, some 70 miles west of the Lakehead, has extended the ore zone. The first hole, put down from the 800-ft horizon at 45°, returned a core length of 70 ft, of which 63 ft. (45 ft. true width) assayed 2.73% copper. The drilling is being carried out to obtain information on the attitude of the No. 6 orebody at the 950-ft horizon. Shaft sinking to 1,400-ft depth is being continued. The company has its sights set on production by or before the end of this year.

QUEBEC

Results of underground development in recent months at Sullivan Consolidated Mines, veteran gold producer in the Val d'Or area, have prompted decision to up mill capacity by the end of this year from 500 to 750 tpd. The increase will involve a change in milling methods through elimination of the present picking belt system and a change from straight cyanidation to a combination of

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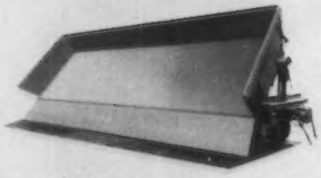

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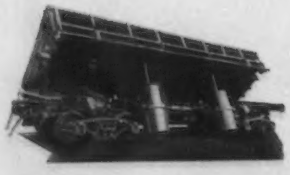

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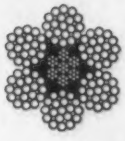
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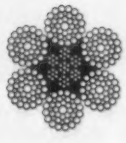
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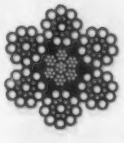
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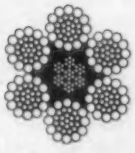
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6794-B

Quebec *(Continued)*

flotation and cyanidation. The changes are expected to result in a normal mill-head grade of $7 per ton, compared with the present grade of $8.

Preparations for the sinking of a 4-compartment shaft have been started by East Malartic Mines at its gold producing mine in the Malartic area. The opening will go down about 1,000 ft initially to provide five new levels from about 4,000 ft to around 5,000 ft. Present workings are at vertical depth of 3,985 ft. The shaft decision was prompted by results obtained in a program of deep drilling on the projected downward extension of the main orebody below the bottom level.

East Sullivan Mines has embarked on an extensive program of depth exploration at its base metal producing property in the Bourlamaque area. Three levels, the 3,300, 3,600, and 3,900 (bottom), are being used and drives have been completed or are in progress on each to cover the entire favorable area. Diamond drilling is to be done from each of the levels to test the area down to 5,000 ft or to 1,000 ft or more below the present workings. In the meantime the company has raised mill rate to peak capacity of about 80,000 tons per month or some 150 tpd over previous rate.

Encouraging results are continuing to be obtained in diamond drilling on the asbestos prospect of Murray Mining Corp. in the Ungava area. It is estimated, however, that at least another season of drilling and perhaps two, will be required to evaluate the property. Drilling has been restricted to one zone so far but asbestos mineralization has been located on surface at spots along a length of over 30 miles. Drilling in two sections, 200 ft apart, has suggested an average ore width of 270 ft to an average depth of 225 ft. Average grade possible is $15 per ton, excluding shorts. More drilling will be required to estimate tonnage and grade.

Work on the Perry zone at the copper producing property of Opemiska Copper Mines in the Chibougamau area is indicating better grade than had been anticipated originally. Shaft on the zone goes to depth of about 2,000 ft and development is being carried out from the upper levels downward.

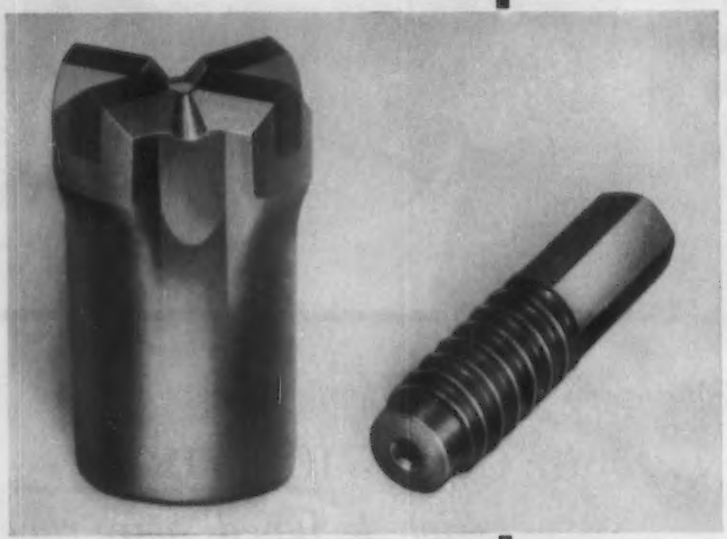
Falconbridge Nickel Mines has taken a 6-month working option on the Marchant Mining Co.'s nickel property in La Motte Twp. The option provides for the completion of a minimum of 5,000 ft of diamond drilling. If the option is exercised a new company would be formed in which Falconbridge and Marchant would share equally. Falconbridge would advance all funds necessary to bring the property into production, including installation of mill and concentrator having a minimum capacity of 300 tpd. Previous diamond drilling had indicated 352,961 tons averaging about 2.95% nickel to the 800-ft horizon.

Campbell Chibougamau Mines and Chibougamau Mining & Smelting have come up with a new gold find with indications of copper on a jointly held property in the Chibougamau area. Initial trenching at one point in the discovery area has shown a shear zone 22 ft wide, of which about 10 ft is a well mineralized quartz vein. Chip samples have shown a width of 12 ft to average 0.214 oz gold and 0.25% copper. The gold values appear to be confined to the quartz vein and do not seem to be directly associated with the copper.

Hull Iron Mines is preparing to install a mining plant following completion of work preparing the Forsyth iron deposit at Ironsides for underground mining. The work, completed under contract, included sinking of a 3-compartment shaft to depth of 750 ft, driving access crosscuts and drifts at the 300, 400 and 600-ft horizons and the cutting of stations at 100-ft intervals from 100-600 ft. Reserves sufficient to supply the proposed steel mill of Quebec South Shore Steel Corp. at Varennes for 15 years, have been estimated by company engineers and verified by independent engineers.

A copper discovery and a copper-zinc find have been made in Joutel and Poirier Twps., some 60 miles north of

(Continued on p 170)



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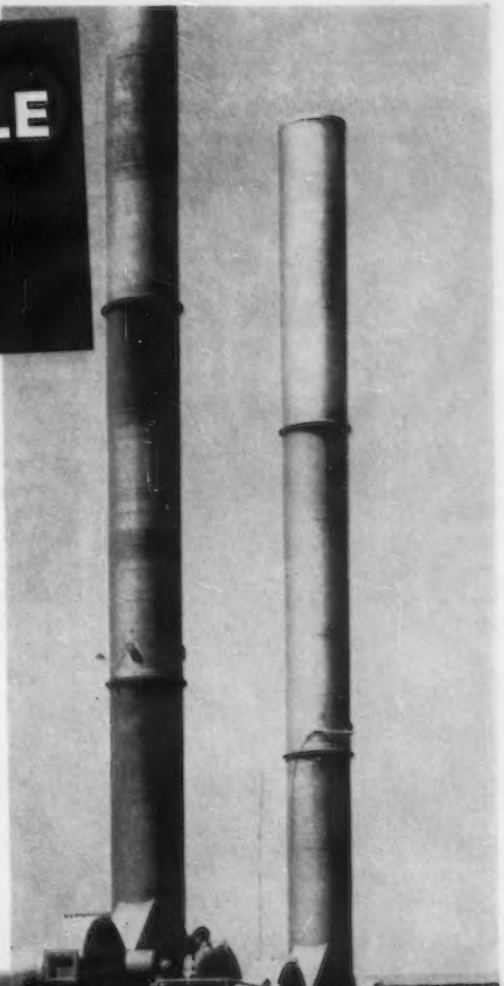

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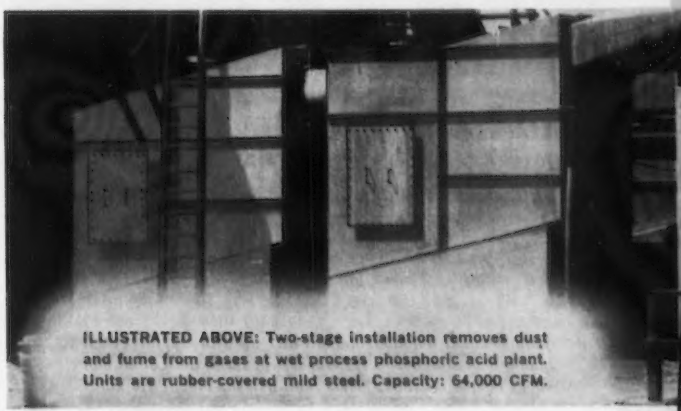
This Jet-Cone in the throat of each Turbulaire-Doyle inlet tube causes a sharp increase in the velocity of the incoming gases—the velocity reaching maximum at the point where the dirt-laden gases impinge upon the scrubbing liquid.

RESULT—**unusually deep penetration of gases into the scrubbing fluid for more complete cleansing of all suspended particles—even those in the fume range.**

Yet there are no moving parts—nothing to require frequent repair or replacement!



ILLUSTRATED ABOVE: Two-stage installation removes dust and fume from gases at wet process phosphoric acid plant. Units are rubber-covered mild steel. Capacity: 64,000 CFM.

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Fuel Cell Powers Demonstration Tractor

THE FUEL CELL—a revolutionary new device to convert the chemical energy in gases directly into electricity without the conventional intermediate stages of combustion, heat, and steam transfer, has moved one step closer to commercial reality. At a recent press conference in Milwaukee, Allis Chalmers Mfg. Co., demonstrated that a tractor powered by a battery of 1,008 fuel cells installed under the hood, and fueled by a mixture of gases—principally propane—could develop a drawbar pull of at least 3,000 lb, enough to pull a multiple-bottom plow.

Fuel cells in the demonstration vehicle measure ¼-in. thick and 12 in. square. A mixture of gases is fed to the anode and adsorbed by a catalyst on the electrode. It is activated there and reacts in the electrolyte which seperates the anode from the cathode. This reaction releases a stream of electrons (direct current) to the external circuit. At the same time, oxygen is adsorbed by the cathode electrode, and it reacts with an electron from the external circuit and with the electrolyte, thus reforming the ion which was used up at the anode electrode. The over-all reaction is the consumption of the fuel gases to yield water and carbon dioxide, and produce a flow of electrons (direct current) through the external circuit.

In the demonstration vehicle, the 1,008 individual cells are joined in 122 units of nine cells each and are arranged in four banks. Electricity can be taken from any combination of the banks. In this sense the new unit is a true battery, capable of performing many of the functions that a storage battery does.

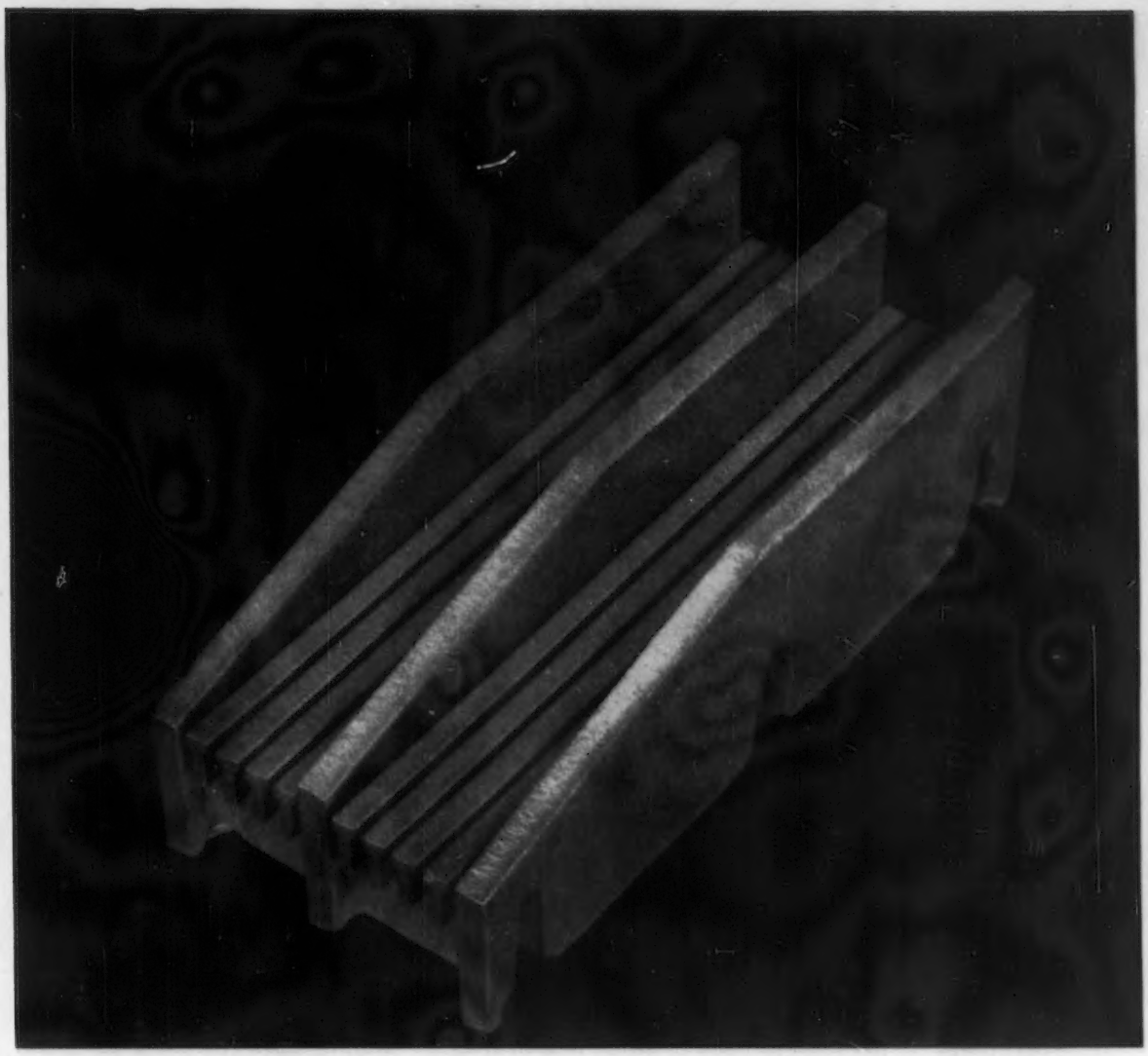
As gases are allowed to flow through the fuel-cell battery, the direct current so generated flows through a compact controller which regulates the electricity supplied to a standard 20-hp, dc motor. The controller permits the tractor driver to regulate speed or reverse the tractor's direction by moving two levers. Using speed control, the operator places the four banks of cells in series or parallel, varying the amount of current going to the motor. To reverse the tractor, the driver moves a second lever, changing the polarity of the current flow to the motor. Total electrical output of the demonstration unit is 15 kw.

Efficiency of the fuel cell is high, a startling 90% as compared to about 40% for the best diesel engine. The fuel cell achieves this high efficiency rate because it does not involve heat in the conversion of chemical energy into electrical energy.

For the mining industry, engineers see in the fuel cell a new and efficient source of electrical energy for the electrolytic refining of metals, and a new source of power for open-pit and underground equipment. For the storage battery industry, a new and highly competitive type of equipment may be in the making. In fact, major battery manufacturers have already shown interest in this new source of mobile power.

Appraisal by GE

WITHIN FIVE YEARS, fuel cells using hydrogen (see E&MJ, September 1959, p 135, and May 1958, p 89) should be ready for commercial use, a General Electric Co. scientist said at a meeting of the American Chemical Society in Atlantic City, New Jersey. But the fuel cells, which produce electricity directly from chemical reactions, will probably not be used for generating large amounts of electric power in the foreseeable future, he said.



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Quebec *(Continued)*

Amos. The copper discovery was made by Prospectors Airways, and the copper-zinc find by Rio Tinto Canadian Exploration. First drilling on the P.A. ground returned copper values of from 1.49% to 2% copper over core lengths of 21 ft and 4 ft respectively. Chalcopyrite mineralization was noted over a core length of 86 ft. The drilling is being carried out to test a coinciding magnetic and electromagnetic anomaly approximately 800 ft long. Other anomalies are also to be tested. The first hole on the Rio ground returned a total of 170 ft of massive sulphides in several sections. The second hole gave 74 ft of which 50.4 ft averaged 6.35% zinc with minor copper and a further 17 ft averaged 4.1% copper with traces of zinc. Drilling is being continued.

NORTHWEST TERRITORIES

North Rankin Nickel Mines, Ltd., is moving to open up a new ore zone. By October 1 the company had expected to start a drive westward on the first level to reach the zone, lying 1,700 ft west of the shaft.

Drilling to date has indicated about 60,000 tons of ore grading 3% nickel and 1.2% copper.

Another possible new zone has been indicated in drilling east of the shaft.

BRITISH COLUMBIA

Mid-West Copper & Uranium Mines Ltd. reports discovery of platinum in diamond drill cores. A special run of an 8-in. section of core showed 0.85 oz platinum and 0.45 oz of gold per ton. It was recovered about 30 ft below an intersection of 2 ft assaying 1.78 oz of gold per ton with 3.53% copper. Testing will be continued and the present concept of the primarily copper property may be completely changed according to president M. F. Maxwell.

Mid-West also reports that the ore shoot providing the principal source of mill feed at the Velvet mine has been definitely established as a replacement orebody. It is about 15 ft thick and the face is currently close to 100 ft wide and continuing to widen with a grade of 4% copper.

IN LATIN AMERICA

MEXICO

The Mexican government, under the direction of the Comision de Fomento Minero (Mining Development Commission) has been experimenting with a

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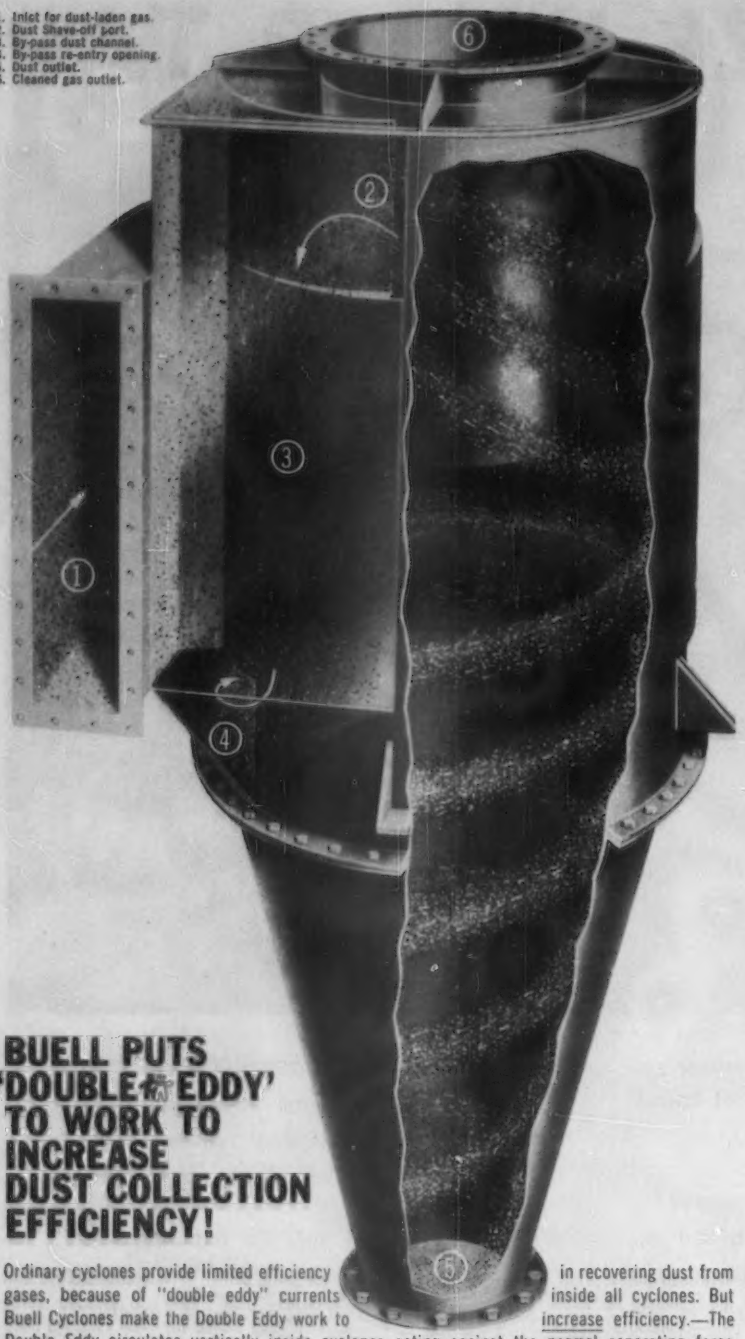
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Mexico *(Continued)*

pilot plant to make something out of the country's low grade phosphoritic rock. Pemex, the government oil company, has been pushing a crash program to construct a series of anhydrous ammonia plants but the government will still have to import large quantities of phosphorus (mostly from Florida) unless the Mexican low grade rock can be put into economic use.

Fomento Minero's chief, engineer Oswaldo Gurria Urgell, told E&MJ that the phosphorus experiment worked and the government was beginning to build a much bigger plant in Saltillo, Coahuila (Mexican State that borders Texas). Total cost for the plants will be $1-million (U.S.).

Apparently the State of Coahuila has plenty of phosphorus rock on hand but it is low grade. The Mexican government feels it must save money on imports and promote new jobs for local industries and this combination makes phosphorus production logical even though the rock is of a low grade.

Earlier in the year, the Mexican government announced that any new phosphorus deposits found in the Lower California peninsula would be considered "national reserves."

The experimental plant bought 11,000 tons of local phosphoritic rock which averaged around 18% P_2O_5 and paid $65 pesos ($5.20) per ton for it delivered. Those working at the experimental plant, according to Fomento Minero, were faced with the job of raising the P_2O_5 percentage of the ore to 28%, the minimum demanded by the chemical industry for productive use of the mineral.

David Contreras Castro, according a Fomento Minero technical report, came up with a solution, unique among the world's chemical and minerals industries. The new Mexican method revolves around a calcination process. The main composition of the Mexican phosphoritic rock was found to be the following: calcium carbonate (32%), flint rock (21%), and tricalcium phosphate which made up 45%. The rest was small amounts of iron and aluminum and other minerals.

Capacity of the pilot plant only runs to 25 to 30 tpd but this figure will be upped considerably when the new, much bigger plant is installed next year. So far, the product coming out of the plant comes up to 28% phosphorus pentoxide (P_2O_5) and with extra washing, this can be upped to 30%, engineers maintain. By the end of next year, the government believes it can turn out the 28 to 30% phosphate product at more than 100 tpd. Right now, average tonnage imports of phosphoritic rock run to around 50,000 tons per year. This would mean Mexico could produce some 36,000 to 40,000 tons of the stuff per year, thus taking a big bite out of the import need.

ARGENTINA

Bids were opened Sept. 30 at the headquarters of the Argentine Military Fac-

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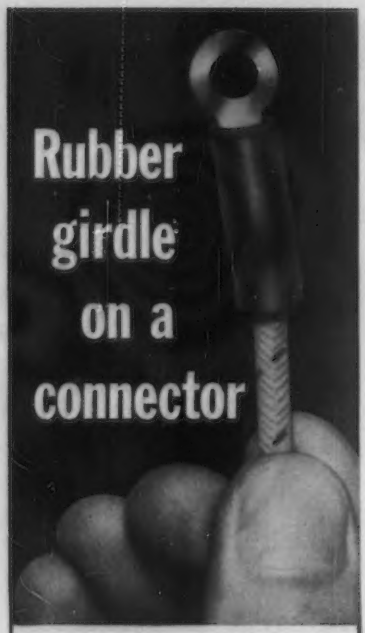

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AMBROSIA LAKE, N.M. was the scene of the shaft sinking operation on the uranium property of Entrada Corp., which used jack hammers and a Cryderman.

Entrada Shaft Sinking Averages 12.2 Ft/Day

BOYLES BROTHERS Drilling Co., 68-year old mining firm of Salt Lake City, claims a local record in shaft sinking in the Ambrosia Lake, N.M., uranium district.

L. Victor Stevens, treasurer and head of the mining department of Boyles Brothers, said the 609-ft, three compartment Entrada shaft bottomed in the west end of the district was driven at rate of 12.2 ft per 24 hours.

This, of course, doesn't include days off, etc.

The shaft is 6 ft 10 in. by 15 ft, 8 in. It consists of two 5½ x 5½ foot compartments and one 5½ x 3 ft compartment.

Coeur d'Alene type lagging was employed.

A 68-ft headframe designed and manufactured by Boyles Brothers was employed in sinking and is used in current production from two zones in Westwater formation.

Although water is a problem in several mines in the district, flow was not encountered in the shaft sunk for Entrada Corp., Albuquerque, N.M. except at 30 ft below lowest ore zone.

The 15 gpm flow is pumped direct to the surface.

Shaft has 8 x 8-in. wall and end plates.

Hoisting equipment was 150 hp double drum, utilizing two buckets with dump doors. Koering dumpsters hauled muck from the headframe dump bin.

J-50 jack hammers were employed in drilling and a standard Cryderman mucker was using in sinking. Power was provided by two Cato 175 kw generators, one being employed as stand by and for auxiliary power. A 600 cfm rotary compressor was used for the jackhammer power.

Stations were cut at 460 and 560 ft levels with slusher trenches at each station. Slusher drifts were put into the 460 ft and 560 foot levels at right angles to the shaft.

During shaft sinking, the two levels were cut and timbered to accommodate measuring pockets and the start of slusher and equipment drifts.

At present, Boyles Brothers as managers and participating partners in the Entrada orebody, are hoisting 1,250 tpd of ore average .22% U_3O_8. A modified system of room and pillar mining is employed. Ore in the 560 ft level is basically on four horizons. Mining is currently from seven headings on this level. The 460 ore level is on one horizon, where mining currently is from two headings.

Eimco 630 crawlers pulling shuttle cars are employed in trackless mining at Entrada shaft.

Objective of mining is to maintain minimum .20% U_3O_8 grade in production of 500 tpd of ore for Phillips Petroleum Co. mill 4½ miles distant.

Argentina *(Continued)*

tories (Dirección General de Fabricaciones Militares, Av. Cabildo 62, Buenos Aires), for the development of the very large iron ore deposits at Sierra Grande, province of Rio Negro. Offers for the erection of a steel mill near the deposits were also invited.

Bidders were the following:

1. Sociedad Minera de Aceros Cruz del Sur, a U.S. consortium with headquarters in Buenos Aires and represented by Dr. Elpidio Lasarte. The offer was made together with the Argentine firm Minera Alumine S.A.I.C. of Buenos Aires. This bid was reported to be the only one which included plans for the erection of a steel mill.

2. Kaiser Engineers International, Buenos Aires, together with Acindar S.A., also of Buenos Aires.

3. Credito Mobiliario y Financiero Bracht S.A., in representation of Fried. Krupp, Essen, Germany.

Bethlehem Hollow Drill Steel Speeds Rock Removal at Niagara Power Project

This battery of wagon drills is boring blast holes for the Balf-Savin-Winkelman section of a 4-mile trench at the Niagara Power Project. When completed, the trench will accommodate twin 46 ft x 66 ft underground conduits, which will carry water from the Niagara River to a 1,950,000-kw power plant now taking shape several miles below Niagara Falls. On this and other major projects, Bethlehem Hollow provides dependable, low-cost drilling under the most rugged conditions. This "old reliable" steel is available in both Carbon and Ultra-Alloy grades.

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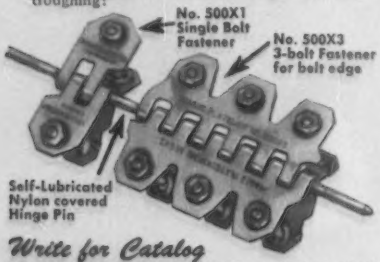

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Argentina *(Continued)*

4. Ferromar S.A. of Buenos Aires, in representation of Ferrostaal A.G., also of Essen, Germany.

5. Semaco S.A. of Buenos Aires.

6. Sociedad Siderugica del Sur S.A. of Buenos Aires.

Terms of the offers were not revealed, but informed circles said that offers ranged from $20- to $300-million. The German Krupp and Ferrostaal offers included general observations and proposals for changes of specifications. Awards, according to a Military Factories spokesman, will be made early next year.

The Sierra Grande deposits are located some 80 miles northeast of the Atlantic seaport of Madryn, in the Chubut province. Proved reserves amount to 70,000 tons, but experts estimate that total reserves may reach 200,000 tons.

Dirección General de Fabricaciones Militares announced it inaugurated a modern sulphur processing plant in the Andes Department, Salta province, at a height of 18,350 ft near the Chilean border.

The plant, the erection and installation of which cost approx. $1-million, will supply 40% of Argentine sulphur requirements, estimated at 50,000 tons annually. Construction of the plant, called La Altiva, lasted less than one year. The plant is located near the Julia Mine operated by the Military Factories, and is connected with a refining plant by an overhead conveyor line.

CHILE

Cia. Minera Peñarroya, which now controls both Compañía Minera Disputada de Las Condes, a Chilean company and Cie. Miniére du M' Zaita, a French one, is going ahead with the old Chagres smelter, 60 miles from Santiago, to smelt the copper concentrates from El Cobre mill currently treating 900 tpd and Disputada mill (700 tpd). Output from both mills will add up to nearly 3,000 tpm of more than 30% copper. Soon El Cobre mill will be stepped up to 1,400 tpd. The Chagres smelter had been down since the end of World War II in 1945 and has two small reverberatories, the first of the modern type to be built in Chile to burn pulverized coal.

Machinery from Japan for the Adrianitas mine has began to arrive at the port of Caldera. This comprises the machinery for the mechanical loading wharf, the construction of the paved road from the mine to the wharf and the exploiting of the open-cast mine. At first production will be 500,000 tpy to be increased later to 800,000 tpy.

Empresa Mantos Blancos S.A. near the port of Antofagasta belonging to Mauricio Hochschild interests will be ready to start production in March 1960. The several orebodies will be mined by the open-cast method at the rate of 2,000 tpd; the treatment method will be vat leaching with H_2SO_4 and the final product will be fire-refined copper. Grade of ore is 2.5% Cu occurring mainly as brochantite. Robert L. Garner, president of the International Finance Corp, recently announced in Washington that his IFC would invest an additional U.S. $900,000 in the enterprise.

Preliminary talks are being carried out in order to form a company to build an iron blast furnace in Coquimbo province. It has been said that Japanese interests are willing to invest $15-million out of about some $30-million that will be required to start production that will not go further than the blast furnace product. The Japanese loan will be paid back in cast iron.

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IN AUSTRALIA

State Premier of Queensland George Nicklin opened a new copper refinery near Townsville for treatment of the entire copper output of the Mt. Isa mines. The Mt. Isa copper-lead-zinc deposits are located about 500 miles west of Townsville.

The new £A3,500,000 ($7,875,000 refinery was part of an expansion program which during the next three years would aim to make north Queensland one of the world's most important copper refining centers, Mr. Nicklin said. The refinery would eventually have a capacity of 100,000 tons a year.

The Australian Federal Govt. is understood to be viewing favorably projects

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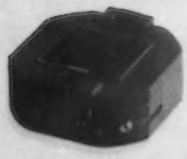

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Australia *(Continued)*

involving bigger local production of aluminium provided private enterprise could be brought into play and invest in the proposed plant. Possible local consumption of 100,000 tons in 1970 makes such plans somewhat urgent and English interests are examining eventual investment in the hitherto Government-owned plant in Tasmania.

The Australian embargo on exports of beryllium will not be lifted but it is expected that the position will be re-examined in a few months' time. Several enquiries from non-Communist countries have reached Australia and local producers do not seem to be satisfied with the price paid to them for deliveries to government stockpiles.

King Island Scheelite Co. will not resume operations until tungsten prices are stabilised on a reasonably high level with an outlook for stability rather than temporary price rises. The mine was closed about a year ago but is being maintained in such a way as to enable quick resumption of operations.

Informed circles predict that Australian exports of iron ore from Western Australia to Japan will definitely commence in 1960, probably in the second part of 1960. Expert opinion now tends to believe that shipments of about 1-million tons a year are warranted and can be made without endangering local reserves.

Mt. Lyell Mining Co. is preparing to increase its output of copper concentrates by 10%. Last year's output was 10,020 tons of copper but this year's grade of copper will be higher. Ore reserves are estimated at 38-million tons (previously 41 million) averaging 0.71 (0.74)% copper, 0.067 oz silver and 0.008 oz gold a ton.

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IN AFRICA

Rhokana Corp. has announced the closure of its uranium plant at Nkana, Northern Rhodesia in view of the world surplus and the fact that most of the uranium-bearing ore in the Mindola area which was being treated has now been mined. Total production to the end of June was 220,000 lb of uranium oxide.

Kaiser Aluminum & Chemical Corp. has accepted the invitation of Prime Minister Nkrumah of Ghana to form an international consortium of aluminum companies to build a smelter near the Kosombo and the Volta River. Edgar F. Kaiser, chairman of the board of Kaiser Aluminum, advised Mr. Nkrumah he would inform him of a definite date on which the proposal will be submitted by the first week in October.

Mr. Nkrumah said he hoped that the proposal will be submitted by the end of this year.

Kaiser Aluminum has held preliminary discussions with several U. S. and foreign aluminum makers on this project. The discussions are continuing.

The smelter would be built in connection with the hydroelectric project the government of Ghana proposes to build on the Volta River. Under terms of its second contract, made with the Ghana government last April 15, Kaiser Engineers is proceeding with preliminary works on the dam and power project. Contract amount is $3 to $4 million.

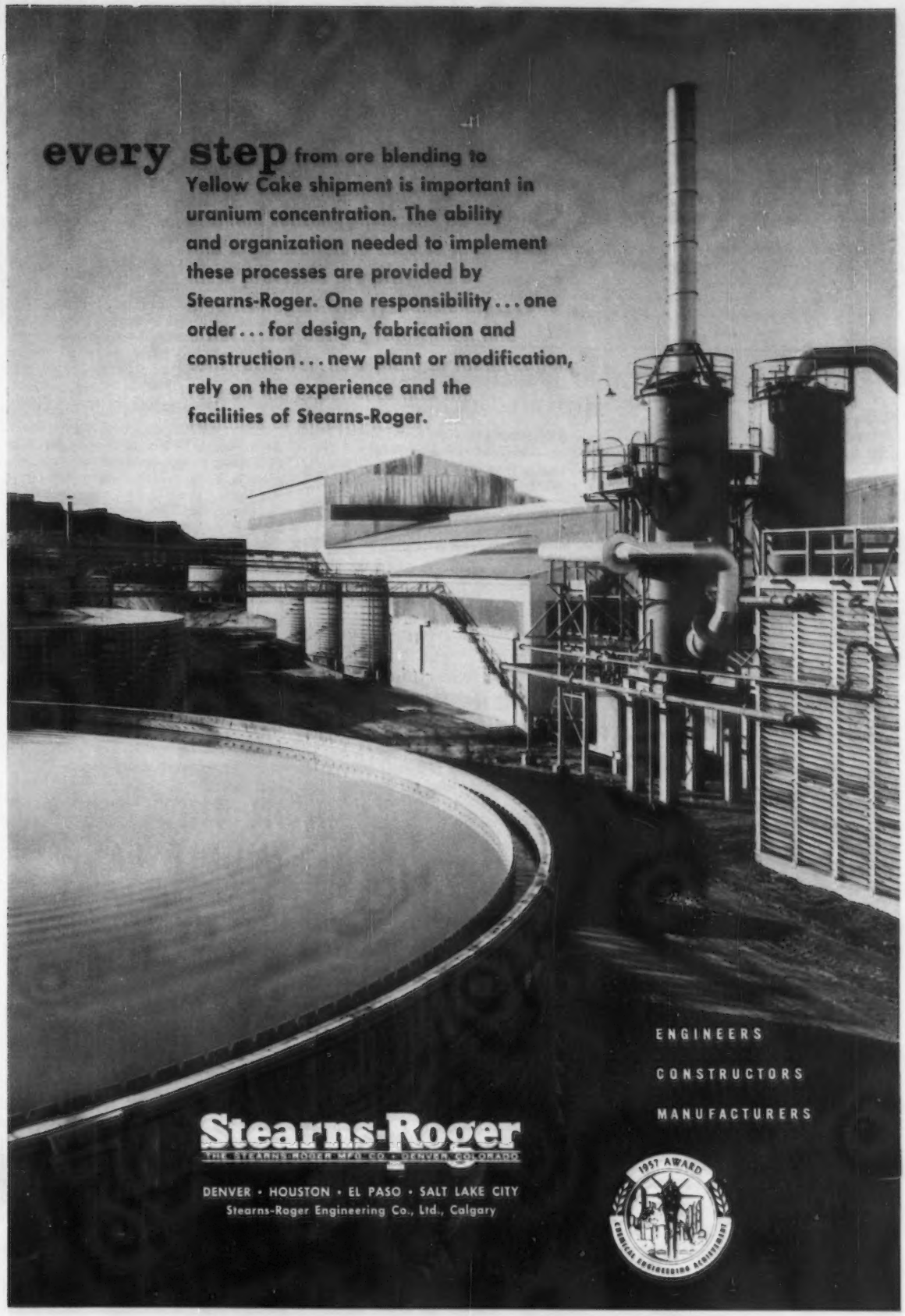
Meantime, the government will make arrangements for financing and will negotiate with aluminum companies.

Bancroft Mine, one of the major copper producers in Northern Rhodesia, has announced plans for sinking a new 400 ft shaft as a first stage in the eventual exploitation of the Karile Bomwe North orebody.

First step in a search for what might be another large and rich gold mining area has been taken by New Consolidated Gold Fields. The company has taken up mineral right options over approximately 60,000 morgen (126,000 acres) in an area extending from the Mooi River, north of Potchefstroom in the Western Transvaal to beyond Fochville which lies immediately south of the rich Far Western group of mines.

There is every indication that the Union Corporation is to start sinking operations on its second mine in the Eastern Transvaal—the Bracken Mine. This mine is about seven miles south of Kinross which is far east of the Rand.

A tarred road has been completed from Winkelhaak, one of the mines in


every step from ore blending to Yellow Cake shipment is important in uranium concentration. The ability and organization needed to implement these processes are provided by Stearns-Roger. One responsibility... one order... for design, fabrication and construction... new plant or modification, rely on the experience and the facilities of Stearns-Roger.
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1957 AWARD

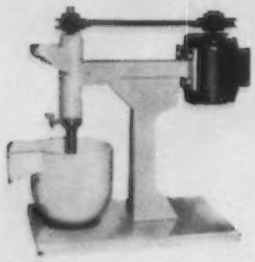
Africa *(Continued)*

the area already in production, to the Bracken Mine. Tenders for the erection of a shaft collar at No. 1. Shaft, Bracken, were due to close on Oct. 9. Cementation of the shaft area by boreholes from the surface has been completed on the Bracken Mine and is almost finished at the Leslie Mine nearby. There is evidence that shaft-sinking at Leslie, another of the Union Corp. mines in the Kinross area, will also commence very soon.

Seeking further outlets for its resources, Rio Tinto Co. Ltd has announced acquisition of two gold mining firms. Acting through a subsidiary organization—Rio Tinto (Southern Rhodesia)—The company bought the entire shareholding of Leslie Gold Mines and the Big Ben Gold Mines both in Southern Rhodesia. The former controls Anmor Mines and Minerals, which owns the Patchway Gold Mine, currently milling at a monthly rate of about 3,000 tons.

Both the mines are reported to hold significant development possibilities. Hitherto, the only interest Rio Tinto had in gold mining was through its Preston East Dome Mine in Ontario, acquired in 1956.

Rio Tinto's main interests remain in copper and uranium. But the gold mining expansion has been interpreted in British mining circles as a move by the company to safeguard itself against a possible downturn in uranium activity. This is on the cards between the early 1960's, when Rio Tinto's contracts run out, and 1970, when demand should have caught up with the accumulated supply surplus.



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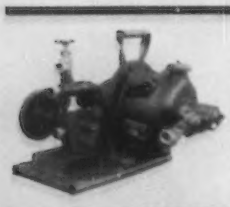

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IN THE PHILIPPINES

Copper production in the Philippines continues to average about 4,000 tons a month from the three principal mines, Atlas Consolidated, Lepanto, and Sipalay in order. From its Toledo mine Atlas maintained in August its normal production of 3,600,000 lb copper from milling about 11,000 tons of 0.62% copper ore. There were no interruptions to regular output during the month. Besides the three leading copper producers, several smaller mines contributed to the months total.

According to Thos. I. Weeks, president of Batong-Buhey Gold Mines, real progress is being made in rehabilitation of this former pre-war gold mine located in Lubuagan, Mt. Province. The Government is making a two-way road to the mine, which when originally built was a remarkable engineering achievement.

Ferrum Exploration & Development Co. has announced it has spent $150,000 to date on its mining properties on Homonhon Island, Samar. J. Yuvienco is mine manager. Extensive test pits have exposed large tonnages of laterite ores. About 500 tons of lateritic nickel-iron ores were shipped for testing purposes to foreign buyers. Positive ore blocks on Homonhon are estimated to contain about 3-million metric tons, all capable of being mined by open pit.

IN THE MIDDLE EAST

Moroccan government has signed $206,000 contract with Fairchild Aerial Surveys Inc. to undertake the first important survey of this country's mineral resources.

Final plans are reported being drawn up for the construction in Israel of a plant to process copper pyrites imported from Cyprus.

The plant will go up in Haifa, Israel, and will be a joint Cypriot-Israeli undertaking.

Initially, the plant is scheduled to produce 30,000 tons annually. According to present plans, production is due to start in January 1961.

Aero Service Corp., Philadelphia, and its affiliate, Canadian Aero Service, Ltd, Ottawa, have started an airborne magnetic survey of different parts of Turkey, considered areas of potential mining and petroleum resources.

The project is expected to take two years, covering one third of Turkey.

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Seamless: Of tin bronze (98¾% copper, 1¼% tin)—also corrugated stainless steel—in sizes ⅛" through 4" I.D. For conveying fluids, chemicals, etc., under conditions of flexure or vibration and to allow for misalignment. Reusable (mechanical type), soldered or welded fittings.

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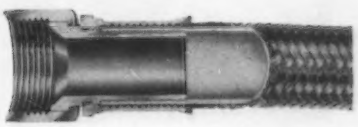

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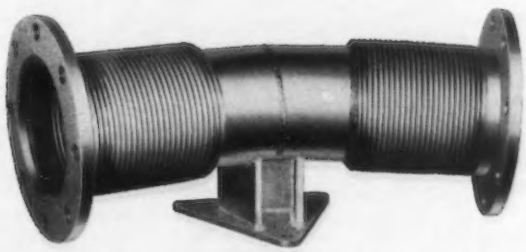

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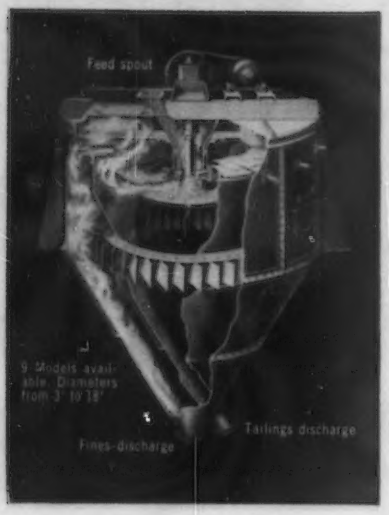

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PERSONALS

Smith

Borcherdt

E. R. Borcherdt and **C. DeWitt Smith** have formed a partnership to offer consulting services in mine management and operations, mine plant planning and layout, and in evaluating mining properties. They opened their main office on November 1 at 369 Pine Street, San Francisco.

Mr. Borcherdt joined the Anaconda Co. in 1920 as an assistant geologist at the Butte Mines. In 1922, he was made underground efficiency engineer and held the post until 1928. That year he became research engineer in charge of Butte Mines' shops, supplies, methods and equipment.

Borcherdt was appointed chief research engineer for Anaconda and its subsidiaries in 1938, and in 1954 was named director of mining research.

Mr. Smith joined the St. Joseph Lead Co. in 1946. From 1946 to 1957, he served the company in the following capacities: chief of the research and development department, Bonne Terre, Mo.; mine captain, Baker Mines, Leadwood, Mo.; superintendent of mines, Edwards Div., Balmat and Edwards, N.Y.; mining engineer and assistant vice president at the company's head office, N.Y.C. During this last assignment, he also served as officer and director of Leadridge Mining Co., Ltd. and other subsidiary companies.

In 1957, Smith came to the Copper Range Co., Boston, as vice president in charge of mining operations at Painesdale, Mich.; and of the refinery of the wholly owned subsidiary, White Pine Copper Co., White Pine, Mich.

James C. Tourek has been appointed vice president for engineering, Vitro Engineering Co. He succeeds **Sidney M. Stoller** who will be retained by the company as an engineering consultant.

Dr. Donald S. Arnold has been named manager of research at American Potash & Chemical Corp.'s main plant at Trona, Calif., according to an announcement by **Joseph C. Schumacher,** AP&CC vice president in charge of research.

Arnold previously was head of the high energy chemicals section of the company's Henderson, Nev., plant research laboratory.

Clarence Thom, director of Denver Equipment Co.'s ore testing division for nearly 25 years, recently became the firm's consulting metallurgist.

Virgil O. McCollum and **E. D. Lemon** have been appointed corporate director and assistant director of industrial relations, respectively, for United States Borax & Chemical Corp.

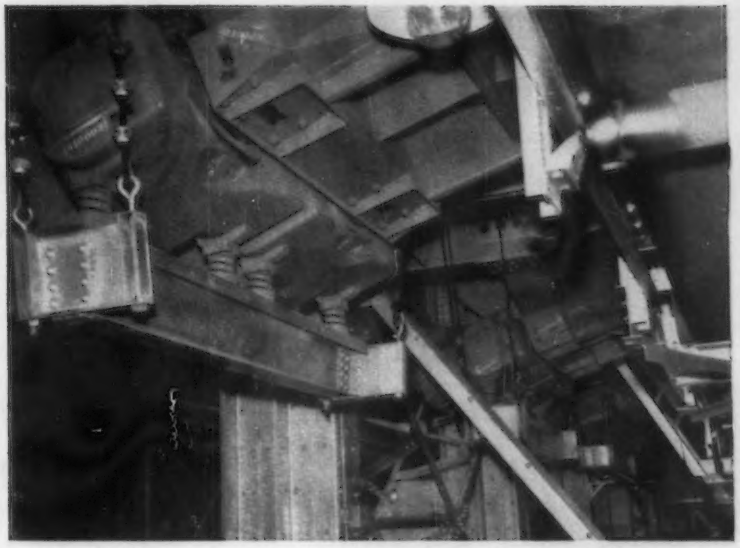
McCollum has served as industrial relations director for the U.S. Potash Co. division at Carlsbad since 1955, and has been with the company since 1932.

Lemon joined Pacific Coast Borax Co., predecessor of U.S. Borax, in 1938. His most recent post was that of assistant to the general superintendent of the firm's Boron, Calif., facility.

United States Borax & Chemical Corp. recently announced plans for a realignment of its management structure. Key feature of the program is the establishment of five functional departments to replace a divisional organization based on product lines.

According to USB&CC president **James M. Gerstley,** the five new departments will each be headed by a vice president who will in turn report to **Hugo Riemer,** executive vice president.

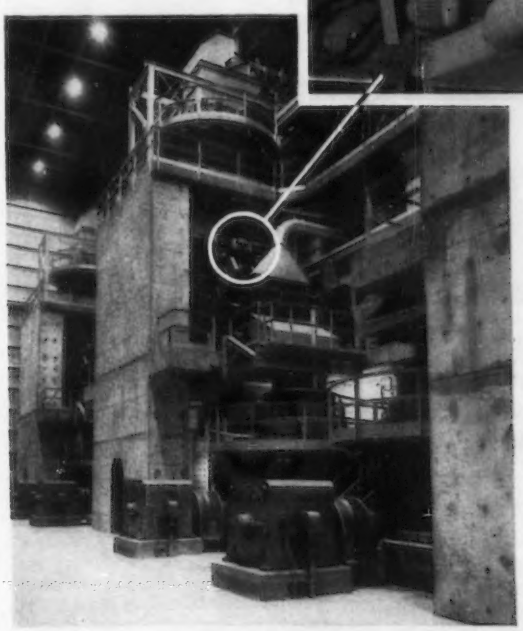
The five vice presidents are: **J. F. Corkill,** former vice president and general manager of the Pacific Coast Borax Div., who will be in charge of industrial and agricultural marketing; **R. T. Edgar**, former vice president for production in the PCB Div., who will be in charge of production for all company products; **D. V. Parker,** who will continue in charge of 20 Mule Team Products marketing; **R. F. Steel,** former vice president in charge of finance and administration,



Jeffrey feeders move coarse ore from surge bin to cone crushers. Balanced vibration assures quiet operation, definite control, low operating and maintenance costs.

Battery of Jeffrey feeders serves hungry taconite crushers

Jeffrey feeders at bottom of cone crusher move ore to next crushing stage.



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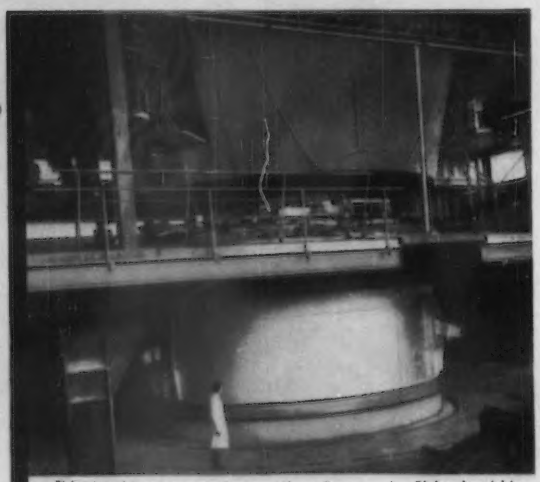

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Personals *(Continued)*

who will become treasurer and head of the administrative department; and **Dr. D. S. Taylor,** former vice president and general manager of the U.S. Borax Research Corp., who will head the technical department. **W. A. Ackerman** will continue as secretary of the corporation.

Charles E. McGraw has been named special vice president of Utah Construction & Mining Co. He will become assistant manager of the company's construction division.

McGraw

For the past four-and-a-half years, McGraw has been vice president and general manager of Marcona Mining Co.'s operations in Peru, and, before this, spent four years with Utah's construction division.

McGraw is a fellow of the American Society of Civil Engineers and a member of the AIME.

William P. Nicholls was elected president of the White Pine Copper Co. at a recent meeting of the board of directors.

He has been a vice president of the company since its incorporation in 1952 and, in 1957, was also appointed general manager.

Mr. Nicholls has been with the Copper Range Co. for the past 24 years and since 1944 has served as an officer of the firm.

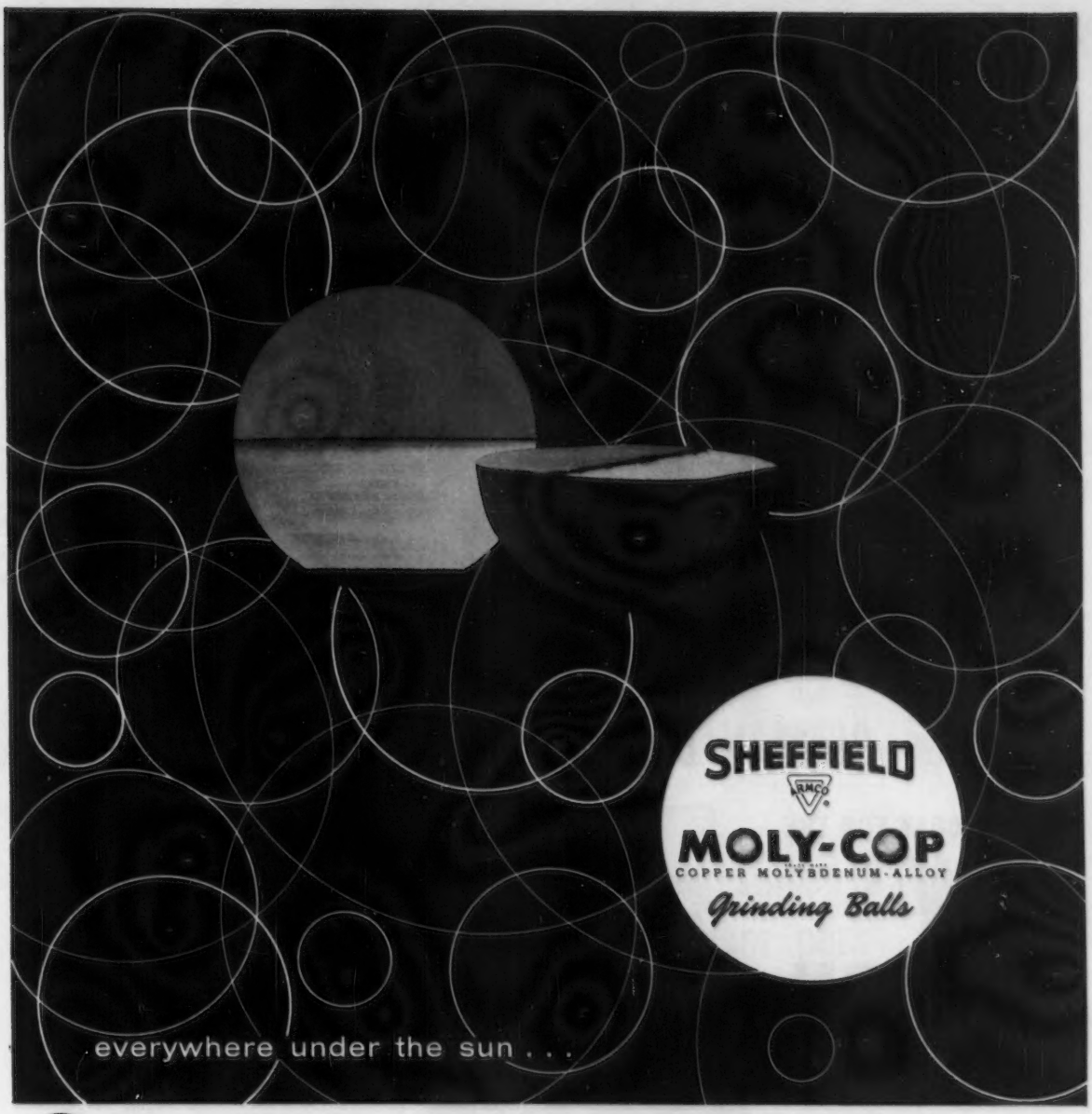
E. C. Stephens, head of Anaconda Co.'s regional exploration office at Spokane, has been named to the advisory board of the Institute of Technology at Washington State university, Pullman. The board is an advisory group on research, educational and extension work at the institute.

Dr. Clifford W. Seibel, formerly assistant director of the U.S. Bureau of Mines in charge of helium activities, has joined the Stearns Roger Mfg. Co. as a full time consultant.

Seibel

Seibel entered USBM's laboratory in 1917 as its first employee devoted to helium. In 1930 he was placed in charge of all of the U.S. Government's helium activities in the field, and during WW II he directed the design and construction of four new helium plants.

Herbert J. Mayer, executive vice president of Western Machinery Co., has been elected a partner of the Edward R. Bacon Co., San Francisco. He will continue as a director of Western Machinery and as executive vice president in charge of the company's machinery distribu-



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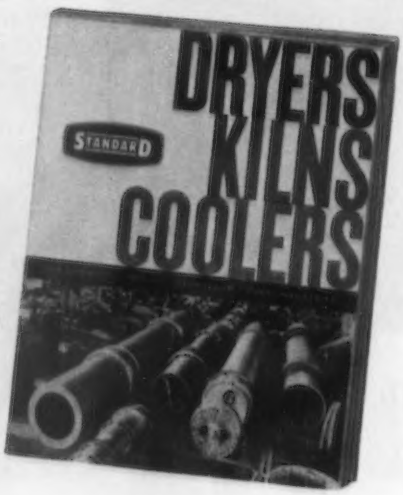

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Personals *(Continued)*

tion businesses presently being handled by the Industrial Sales and Smith Booth Usher company divisions.

OBITUARIES

Churchill Gear Sheldon, 71, retired sales engineer for Ingersoll Rand Co., died recently at Salt Lake City.

Mr. Sheldon began his career with Chino Copper Co. in 1909, later served as mining engineer with Mesabi Iron Co., Babbit, Minn., and then as chief engineer for the Munro Iron Mining Co.

Edwin J. Appel, manager of Reynolds Metals Co.'s power and new facilities department, Richmond, Va., died recently in New York City.

He joined Reynolds in 1940, when the company began building its first reduction plant at Listerhill, Ala. In 1943 Mr. Appel was elected an assistant vice president, and, in 1954, was appointed general manager of Reynold's western reduction division.

Kellogg Krebs, 59, co-founder and president of Equipment Engineers Inc., Palo Alto, Calif., died in August.

Krebs

Mr. Krebs graduated from the University of California in 1923 and went to work for Kennecott Copper. He then joined Braden Copper and worked for them for five years in South America. In 1928, he was hired by American Cyanamid as a metallurgical engineer, and, in 1939, became resident manager and was stationed at Azusa, Calif.

Krebs left the company in 1949 and moved to San Francisco where he founded Equipment Engineers Inc. He designed much of the firm's classifying equipment, including the Krebs cyclone.

LETTERS

Direct Reduction

Would you please send me the names and addresses of companies or people who have developed direct reduction processes so that I might write to them for complete details. This is in connection with your article, "Industry Looks at Direct Reduction", December, 1957.

Leonard G. Moats
Poplar Bluff, Missouri

• There are more direct reduction patents than you can shake a stick at—over 275, with 9 or 10 new ones in the past month or two. Here are the addresses of those most talked about:

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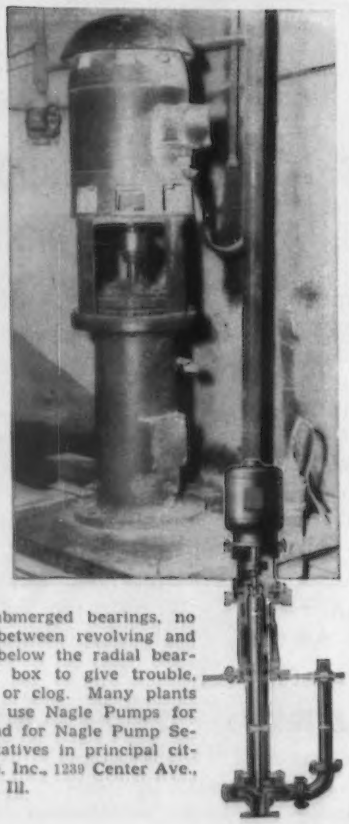

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CORRECTION

The editorial "Who Owns the Sea?" (E&MJ September 1959, p 87) mentioned a remote-controlled suction dredge that had appeared on p 209 of the July 1959 issue. The reference should have been for June 1959, p 209.

Estimating Reserves

(Continued from p 102)

tion appears to be reasonably accurate. The obvious way to improve accuracy would be to sample in greater detail, i.e. drill more holes.

2. Overestimating reserves, which results in extracting less than calculated values from a deposit, usually results from lack of continuity between ore holes. How to recognize this characteristic from drill data remains a problem. Deposit No. 1 does suggest lack of continuity in the irregular scattering of ore holes among barren and mineralized holes. In contrast, Deposit No. 2 suggests strong continuity in the clustering of a number of ore holes within a single area.

3. Underestimating reserves, which results in extracting more than calculated values from a deposit, usually results from the presence of thick ore sections which were not cut by drill holes or incompletely outlined by drilling, as in Deposit No. 2.

Acknowledgments

The work was done by the exploration department of Climax Uranium Co., Grand Junction, Colo. Cooperation extended by the Grand Junction Operations Office of the Atomic Energy Commission is appreciated.

The author wishes to thank A. M. Mastrovich, general manager, Climax Uranium Co., for permission to publish this paper.

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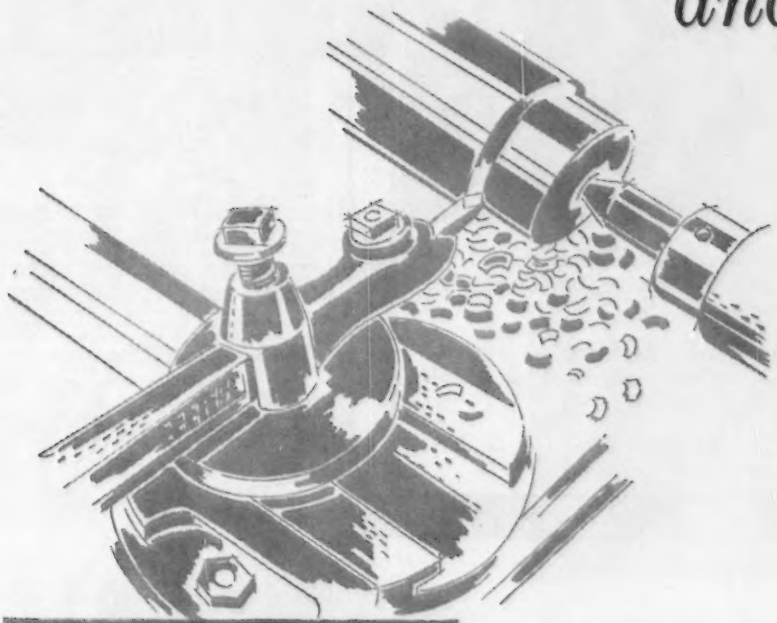

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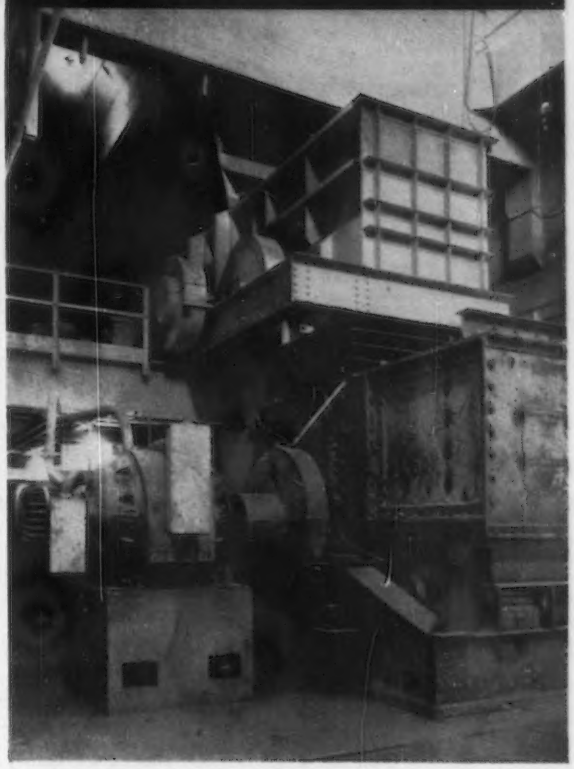

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***Indicates more product information may be found in company advertising appearing in E&MJ June 1959 Mining Guidebook and Buying Directory Issue. Check your Guidebook Index.**

*Acker Drill Co. ... 180
*Ainsworth & Sons Inc., Wm. ... 178
*Allen-Sherman-Hoff Pump Co. ... Second Cover
*Allis-Chalmers ... 52, 67, 68, 137
*American Cyanamid Co. ... 63
American Manganese Steel Div., American Brake Shoe Co. ... 8-9
*Anaconda Wire & Cable Co. ... 181
Armstrong-Bray & Co. ... 176
Atlas Car & Mfg. Co. ... 176
*Atlas Copco ... 119
*Autocar Div. of White Motor Co. ... 174

*Babcock & Wilcox Co., Boiler Div. ... 155
*Bethlehem Steel Co. ... 37, 151, 175
Bixby-Zimmer Engrg. Co. ... 130
Booth Co. ... 180
*Boyles Bros. Drilling Co., Ltd. ... 56
*Brunner & Lay, Inc. ... 166
*Bucyrus-Erie Co. ... 162
*Buell Engineering Co. ... 172

*Caterpillar Tractor Co. ... 5, 14-15, 190
*Chicago Pneumatic Tool Co. ... 153
*Christensen Diamond Products ... 10
*Clark Equipment Co. ... 149
*Colorado Fuel & Iron Corp. ... 173
Construction Aggregates Corp. ... 178
*Crosby Laughlin ... 190
*Curtiss-Wright Corp., South Bend Div. ... 125

Deister Machine Co. ... 188
Denver Equipment Co. ... 25, 117
*Detroit Diesel Engine Div., General Motors ... 54
*Dodge Mfg. Corp. ... 64
*Dow Chemical Co. ... 50-51

*Eddystone Div., Baldwin-Lima-Hamilton ... 187
*Eimco Corp. ... 59, 61
*Elektrokemisk A.S. ... 182
*Euclid Div., General Motors ... 159
*Exide Industrial Div., Electric Storage Battery Co. ... 142

*Flak Corp. ... 143
*Farris Flexible Valve Corp. ... 134
*Flexible Steel Lacine Co. ... 168

*Gardner Denver Co. ... 62
*General American Transportation Corp. ... 58
General Electric Co. ... 6-7, 49, 146-147
Getman Bros. ... 186
Goodrich Aviation Products B. F., A Div. of B. F. Goodrich Co. ... 133
*Goodrich Industrial Products Co., B. F. ... 3
*Goodrich Tire Co. B. F., A Div. of B. F. Goodrich Co. ... 47
*Goodyear Tire & Rubber Co. ... 11

Hammermills, Inc. ... 191
*Hardinge Co. ... 148
*Harnischfeger Corp. ... 38-39
*Hendrick Mfg. Co. ... 169
*Hewitt Robins ... 154

*Ingersoll-Rand ... 1
Industrial Brownhoist Corp. ... 31
*Industrial Physics & Electronics Co. ... 161
*International Harvester Co. ... 27, 28-29
International Nickel Co. ... 138

*Jeffrey Mfg. Co. ... 183
*Jenkins Bros. ... 115
*Joy Mfg. Co. ... 30, 123, 182

*Kaiser Engineers ... 157
*Kennedy-Van Saun Mfg. & Engrg. Corp. ... 69
Koehring Co. ... 70-71

*LeRoi Div. of Westinghouse Air Brake Co. ... 163
*LeTourneau-Westinghouse Co. ... 53, 55, 57
*Link-Belt Co. ... 12
*Lukens Steel Co. ... 145

*Mack Trucks, Inc. ... 34-35
*Marion Power Shovel Co. ... 141
*Magor Car Corp. ... 164
Mayo Tunnel & Mine Equipment Co. ... 191
*McNally-Pittsburg Mfg. Corp. ... 127
Michigan Chemical Corp. ... 182
*Mine & Smelter Supply Co. ... 135
*Mine Safety Appliances Co. ... 129
*Minneapolis-Honeywell ... 60
*Mobile Drilling, Inc. ... 156

*Nagle Pumps ... 188
*National Filter Media Corp. ... 150
*National Malleable & Steel Castings Co. ... 73
*Naylor Pipe Co. ... 171
*New York Engineering Co. ... 188
*Nordberg Mfg. Co. ... 74-75
*Northwest Engrg. Co. ... 13

Ohio Brass Co. ... 177

*Pipe Linings Div. of American Pipe & Construction Co. ... 152
Porter Company, Inc., H. K. Thermoid Div. ... 160
*Process Equipment Div., General American Transportation ... 58

*Raybestos-Manhattan, Inc. ... 78-79
*Roebling's Sons Corp., John A. ... 72

Sanford-Day Iron Works, Inc. ... 26
*Sauerman Bros., Inc. ... 158
Searchlight Section ... 192-195
*Sheffield Steel Co. ... 185
*Sly Mfg. Co., W. W. ... 136
*Smidth & Co., F. L. ... 36
*Smit & Sons Inc, J. K. ... 170
Smith Engrg. Works ... 65
Spang & Co. ... 140

*Sprague & Henwood, Inc. ... 144
*Standard Oil Co. of California ... 16
*Standard Steel Corp. ... 186
*Stearns Roger Mfg. Co. ... 179
Stephens-Adamson Mfg. Co. ... 48
*Sturtevant Mill Co. ... 184

*Texaco, Inc. ... 40
*Texas Gulf Sulphur Co. ... 189
*Timken Roller Bearing Co. ... Fourth Cover
*Traylor Engrg. & Mfg. Co. ... 66

*United States Rubber Co., Mechanical Goods Div. ... 113
*United States Steel Co. ... 76-77

*Victaulic Co. of America ... 139

*West End Chemical Co. ... 131
*Western Machinery Co. ... 121
*Western Precipitation Corp. ... 167
*Western Rock Bit Mfg. Co. ... 132
*Westinghouse Electric Corp. ... 32-33
*Wheel Trueing Tool Co. ... Third Cover
*Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp. ... 165
*Wilfley & Sons, A. R. ... 80

•

PROFESSIONAL SERVICES ... 192

•

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.
EMPLOYMENT OPPORTUNITIES ... 193

•

BUSINESS OPPORTUNITIES ... 193
PROPERTY FOR SALE ... 193, 194

EQUIPMENT (Used or Surplus New)
For Sale ... 193-195
Wanted ... 194

ADVERTISING SALES STAFF

Atlanta 3 ..... M. H. Miller, 1301 Rhodes-Haverty Bldg., Jackson 3-6951
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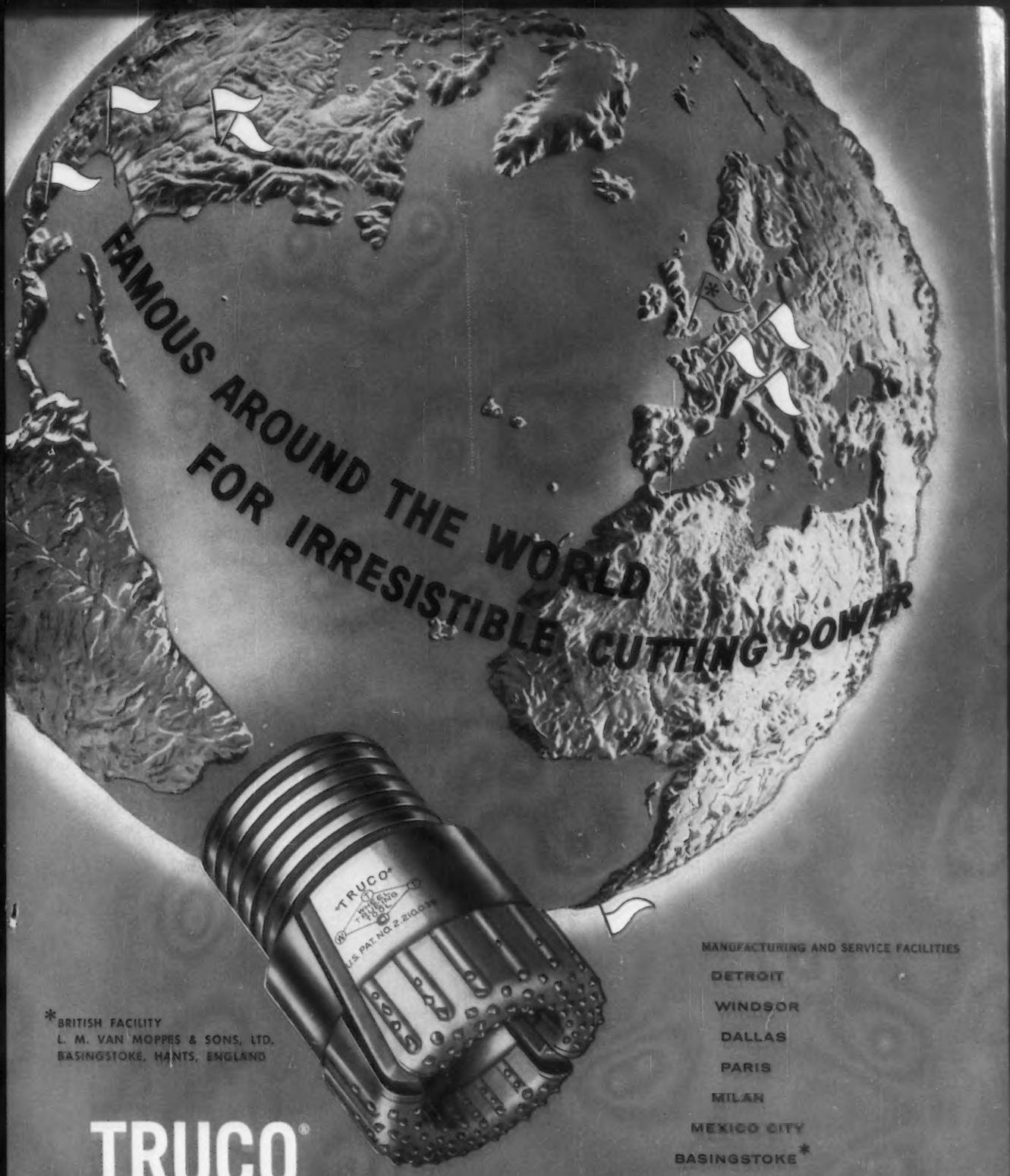

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